RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

Vol. 75 AUGUST 1960 No. 2

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Radiological Society of North America

FORTY-SIXTH ANNUAL MEETING, NETHERLAND-HILTON HOTEL

CINCINNATI, OHIO, DECEMBER 4-9, 1960

Scientific Sessions

Refresher Courses

Scientific Exhibits

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RADIOLOGY

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PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

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Percutaneous Retrograde Catheterization of the Left Ventricle and Systemic Arteries of Man[1]

CHARLES T. DOTTER, M.D., and GOFFREDO G. GENSINI, M.D.

SINCE THE prehistoric time when one of our ancestors learned that a sword could be thrust into the heart of his fellow man, progress has taken many pathways to varying objectives. The importance of one of the more peaceful of these objectives, controlled access to the left ventricle for medical purposes, has been evidenced by the acceptance of transthoracic needle puncture as a means justified by the end. That the left heart can now be reached without recourse to this or similar crude throwbacks to neolithic technic is, in large part, due to the efforts of Prioton and his colleagues (1). Following the valuable leads already provided by others (2–6), these French physicians developed an ingenious percutaneous technic for catheterizing man's left ventricle and systemic arteries. In one form or another, the method has subsequently been employed by numerous other workers (7–11).

Guided percutaneous arterial catheterization is superior to, and will no doubt supplant, translumbar aortography. It is the diagnostic method of choice for the anatomic demonstration of patent ductus arteriosus, coarctation, and other abnormalities affecting the aortic arch; it provides reliable means for the study of aortic valvular disease and the direct demonstration of the hemodynamic consequences of mitral insufficiency; its value in pelvic, abdominal, cerebral, and peripheral arteriography is becoming recognized as familiarity is gained with this simple and effective technic. Experience acquired from the study of 157 patients with cardiovascular disease by this method forms the basis for the present report.

METHOD

In its essentials, percutaneous guided arterial catheterization is achieved by inserting a needle into a systemic artery—usually the femoral—and passing through the needle a long, flexible coil spring. The needle is withdrawn and polyethylene tubing slid sleevewise down the guide and into the arterial lumen. Figure 1 illustrates the salient features of this procedure. Fluoroscopic observation of the metallic guide facilitates catheter placement: when the latter has been accomplished, the guide is withdrawn, leaving the polythene tubing for the injection of radiopaque material and manometric observations. A more detailed description of technic is reported elsewhere (12).

The key to the procedure is a long, flex-

[1] From the Department of Radiology, University of Oregon Medical School, Portland Ore., and the Monsignor Toomey Cardiopulmonary Laboratory and Research Department, St. Joseph's Hospital, Syracuse, N. Y. Presented at the Forty-fifth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 15–20, 1959.

Work in the University of Oregon Medical School's Minthorne Memorial Laboratory for CV Research through Radiology was supported by grants from the United States Public Health Service (H-3275), the Oregon Heart Association, and the Mallinckrodt Chemical Works.

ible, coiled wire spring containing an inner wire stiffener.[2] This serves the same general purpose as a plumber's "snake."

Since, in cooperative patients, general anesthesia is not required, the technic may be used on an out-patient basis. In most instances the femoral approach is selected. With the inguinal region suitably prepared, Novocain is injected and, through a nick in the skin, a needle large enough to admit the guide is inserted into the femoral artery. With its tip in a coaxial position, the guide is passed through the arterial blood spurting from the needle and advanced 3 or 4 inches up the arterial lumen. The needle is removed and polyethylene tubing (6 inches shorter than the spring guide) is slid along the guide, and with a slight rotary motion, into the lumen of the artery. Since the lengths of guide, tubing, and wire stiffener are known, their relative positions may be adjusted at will. Arterial and transaortic valvular passage are carried out with an inch or two of flexible spring guide projecting beyond the end of the tubing (the stiffening wire having been withdrawn accordingly). In the presence of a normal aortic valve, transvalvular passage of the catheter is generally accomplished in a matter of seconds; in the presence of aortic stenosis, successful passage requires more time and a reasonable amount of patience. Here it is likely that the role of chance at least equals the skill of the operator. Electrocardiographic monitoring warns of inadvertent coronary catheterization or induced cardiac arrhythmia. Premature ventricular contractions are common during the period of ventricular invasion. With the tubing positioned as desired, the guide is withdrawn, allowing manometric observations, impedance plethysmography (13), the collection of blood samples, and the introduction of radiopaque agents or other drugs.

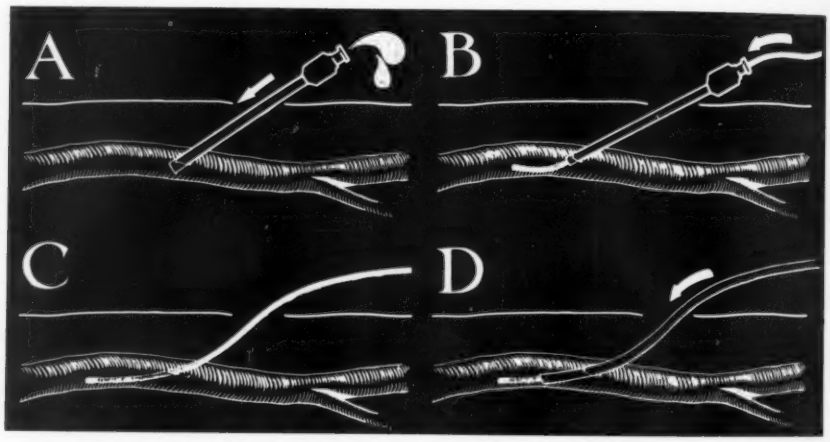

Fig. 1. Introduction of guided interarterial catheter.
A. Through a nick in the skin, the needle is inserted into the artery and the sharpened inner stylus (not shown) is withdrawn, allowing blood to spurt forth.
B. The spring guide is passed through the needle into the arterial lumen.
C. The needle has been withdrawn, leaving the guide in the arterial lumen.
D. The polythene tubing is threaded over the guide into the arterial lumen.

For purposes of contrast visualization, the number of injections and the filming technics are best determined on the basis of the suspected abnormality. Even though an extra injection is required, we believe it is good practice routinely to perform supravalvular injection following ventriculography. Rapid serial radiography at two to six exposures per second is employed. Though the use of biplane filming apparatus would reduce the number of

[2] These guides may be obtained commercially, ours currently being purchased from the Syracuse Spring Corporation (Erie Boulevard East, Dewitt, New York) at a cost of $3.95 in lots of 12.

needed injections, it is by no means a necessity of modern contrast visualization (14). The two-for-the-price-of-one advantage of increased flexibility is outweighed by the lower cost and simpler maintenance considerations inherent in uniplane apparatus, the use of which is further justified by the development of safer contrast media. A preferable alternative is offered by bimodal technics for radiographic recording, wherein the hemodynamic advantages of cinefluorography are simultaneously combined with the superior anatomic detail of direct radiographic recording. Such a unit is now in the planning stage.

Following the study, an elastic pressure dressing is applied over the puncture site. A chunk of sea sponge incorporated in the dressing has been helpful in preventing post-puncture bleeding. Early ambulation appears to prevent rather than precipitate the foregoing.

RESULTS

We have used this technic a total of 157 times as of May 3, 1960, with 2 fatalities. In a two-year-old boy with tetralogy of Fallot, irreversible cardiac arrest occurred during an apparently uneventful recovery from general anesthesia approximately an hour following the conclusion of the examination. There is no reason to attribute this death to the particular technic employed; it might as well have followed venous angiocardiography or tonsillectomy. In another patient, an elderly woman with severe polyvalvular rheumatic heart disease and cardiac decompensation, ventricular fibrillation followed a supravalvular injection of contrast agent. Thoracotomy, though prompt, was fruitless; severe aortic insufficiency prevented adequate myocardial oxygenation, and, therefore, the restoration of an effective heart beat.

A transient hemiplegia appeared eight hours after examination in a nine-year-old girl with transposed great vessels and a high interventricular septal defect. This was believed to be due to inadequate heparinization, a prolonged procedure, and possibly the effect of postoperative dehydration. In rare instances, bleeding or hematoma formation has resulted. This is avoidable through proper application of the pressure dressing, observation of the unreacted patient when anesthesia is used, and instruction of ambulatory patients concerning application of local pressure, should bleeding around the dressing become evident. In one patient in whom a test dose of contrast agent was injected into a branch artery, there was subsequent local hematoma formation and pain. The force of rapid injection may exceed the capacity of such vessels and test injections are best made with care.

It is our opinion that, in general, the hazard of this procedure is roughly equal to that of retrograde aortography without the local arterial morbidity of the latter. Careful heparinization and good post-procedural hemostasis will contribute to safety.

In connection with the studies herein reported, we have employed Urokon sodium 70 per cent, Hypaque M 90 per cent, and Ditriokon.[3] Ditriokon has the advantage of relatively low viscosity and requires no pre-injection warming. Its clinical application is the subject of a separate report (15). All three agents provided satisfactory opacity.

CLINICAL APPLICATIONS

The usefulness of this technic in providing detailed anatomic studies of the left ventricle, aortic valve, coronary arteries, and the aorta and its major branches is demonstrated in Figures 2 through 11. In the diagnosis of certain lesions, it has emerged as the procedure of choice; in other areas, percutaneous retrograde arterial catheterization opens new avenues for clinical evaluation.

Mitral Insufficiency: Only in the presence of mitral incompetence or prolonged diastolic arrest, does the injection of contrast material into the left ventricular cavity result in visualization of the left atrium

[3] A new concentrated iodine-containing contrast substance made available by the Mallinckrodt Chemical Works.

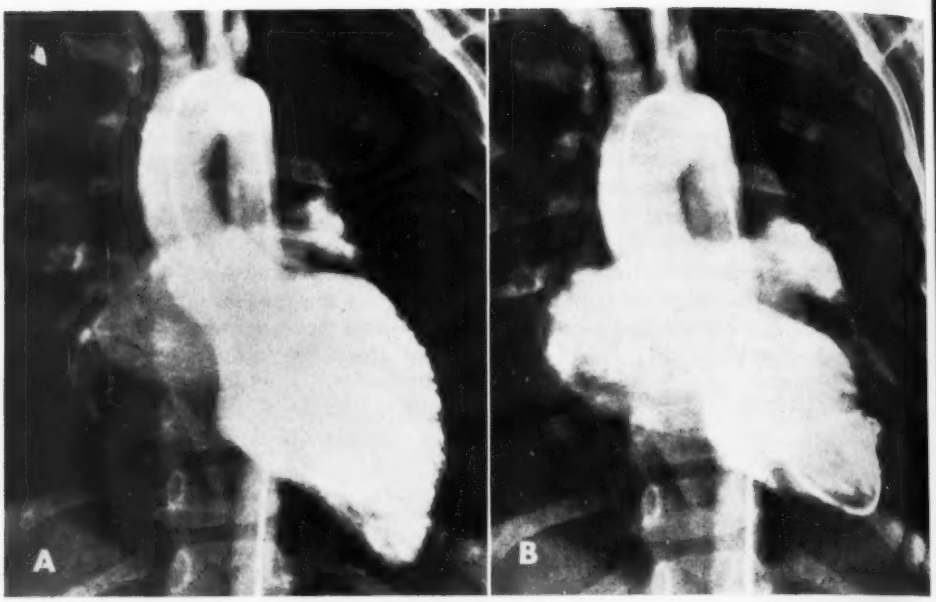

Fig. 2. Mitral insufficiency in a 5-year-old girl (VOMS 26–70–92). Injection into left ventricle. A. During ventricular diastole. B. Systole. Ventricular contraction results in decided opacification of the left atrium and its auricular appendage.

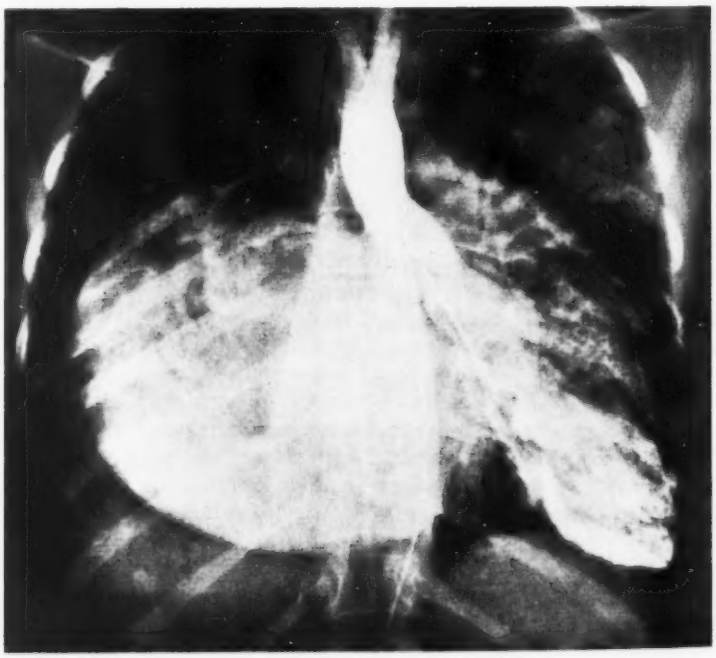

Fig. 3. Mitral insufficiency with marked left atrial dilatation in a 32-year-old female (VOMS 25–28–01). A left ventricular injection results in massive regurgitation of contrast substance into a tremendously enlarged left atrium. In this patient the remainder of the heart could have been contained within the left atrium.

(16). This observation is constant, and the information is of sufficient value that, in the preoperative work-up of patients with mitral insufficiency, physicians have, in the past, been willing to resort to transthoracic needle puncture in order to obtain it. The results suggest that the degree of mitral insufficiency may be determined by comparing the relative time of opacification of the aorta with that of the left atrium. Certainly it is possible to gauge with fair accuracy the proportion of contrast material regurgitated into the left atrium following an injection into the ventricle. Examination of the patient in the right anterior oblique projection provides a useful view of the ventricular aspect of the mitral valve and, in certain instances of incompetence, can demonstrate the exact site of regurgitation. It has been possible, for example, to demonstrate regurgitation through the aortic but not the other mitral cusp. Thus far, in our hands, this procedure has only twice resulted in catheterization of the left atrium. Both transmitral catheterizations were inadvertent. It should prove possible to accomplish this intentionally, although we have not as yet made the attempt. In Figure 2 is reproduced an unequivocal demonstration of mitral insufficiency in a five-year-old girl, thought to be due to a congenital cleft. Figure 3 shows retrograde opacification of a giant left atrium associated with rheumatic mitral insufficiency in a thirty-two-year-old female.

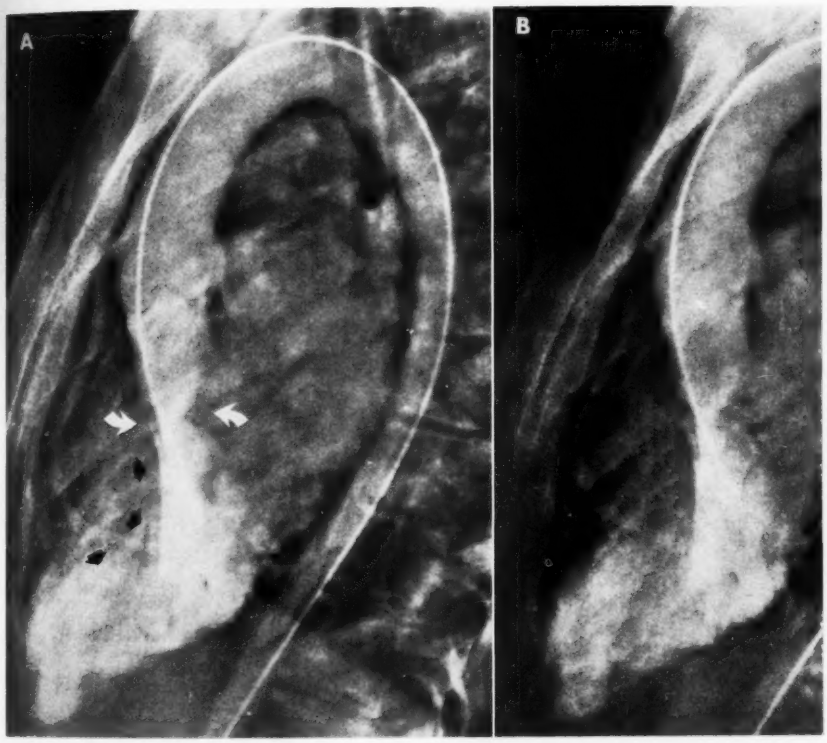

Fig. 4. Subaortic stenosis, subendocardial fibroelastosis, and hypertrophic obstruction of the left ventricular outflow tract in a 15-year-old female (VOMS 24–57–10). Views during diastole (A) and systole (B) in left lateral projection disclose an obstructive ridge about 2.5 cm. below the level of the aortic valve (white arrows) and, in addition, bulging of the interventricular septum into the outflow tract of the left ventricle (black arrows). Although surgery was planned, the gradual development of intractable heart failure led to death several months later. Autopsy confirmed the previous findings and indicated the presence of subendocardial fibroelastosis.

Fig. 5. Interventricular septal defect in a 16-year-old boy (VOMS 27–76–79). Films in left oblique projection following injection into the ventricle reveal direct spread of contrast material across the interventricular septum and into the right ventricle. A. Pulmonary hypertension was present but the predominant direction of shunt was from left to right. B. Film obtained one-half second later shows filling of the pulmonary arteries as well as the thoracic aorta.

Hypertrophy, Dilatation, and Other Abnormalities Involving the Left Ventricle: The form and configuration of the left ventricle are beautifully demonstrated by the high grade of contrast visualization achieved with the use of large-bore polyethylene tubing. Electrocardiographically timed radiographic exposures permit accurate estimation of left ventricular wall thickness and chamber volume at various phases of the cardiac cycle. Although we have not yet so employed it, the technic should provide an excellent means for demonstrating left ventricular aneurysm, localized thinning, and scar formation following myocardial infarction.

Left ventriculography provides the only definitive approach to the clinical diagnosis of hypertrophic outflow-tract obstruction of the left ventricle. In one case (Fig. 4) the films demonstrated a rim-like area of subaortic stenosis 1.5 cm. below the aortic valve, narrowing of the left ventricular conus, and dilatation of the left ventricular cavity proper with marked thickening of its walls. At autopsy, several months later, this patient was found to have subendocardial fibroelastosis in addition to the foregoing. Pressure studies at the time of ventriculography revealed a definite pressure gradient proximal to the aortic valve.

Fig. 6. Aortic insufficiency, gross, in a 48-year-old female with clinical diagnosis of aortic insufficiency (St. Joseph's Hospital case). Right posterior oblique projection (45 degrees). Contrast substance injected into the ascending aorta enters the left ventricle due to marked aortic valvular insufficiency.

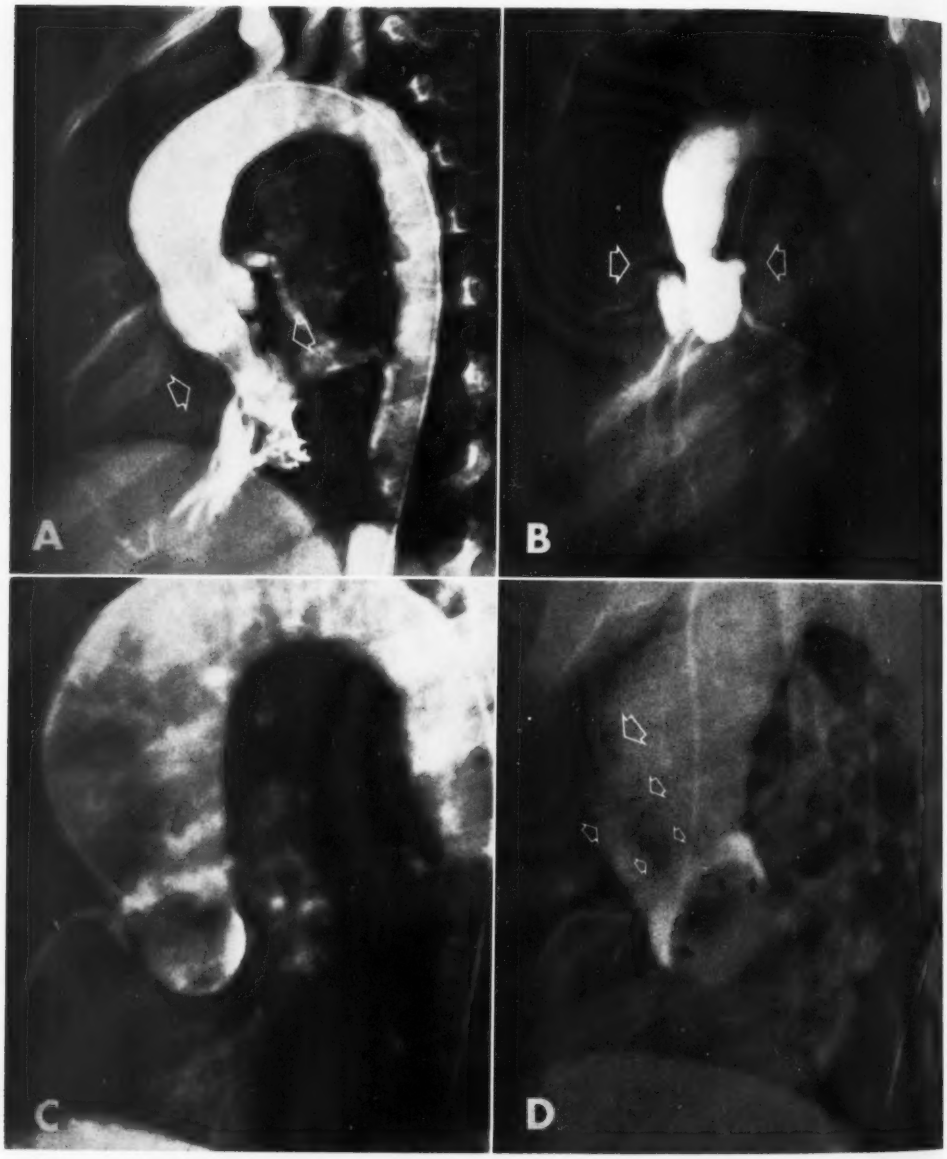

Fig. 7. Aortic stenosis: four varieties. A. Subaortic stenosis (arrows) in a 9-year-old girl (VOMS 22-04-31). B. Supravalvular aortic stenosis (arrows) in a 15-year-old boy (18) (VOMS 22-60-26). C. Acquired rheumatic aortic valvular stenosis in a 15-year-old male (VOMS 27-69-28). D. Congenital valvular aortic stenosis showing dome (black arrows) and jet (white arrows) in an 18-year-old male (VOMS 27-22-28).

This procedure is by far the best available for demonstrating the anatomic lesion of interventricular septal defect with left-to-right shunting of blood (Fig. 5). It provides an exact localization of the defect and a reasonably accurate estimate of its size.

Lesions of the Aortic Valve: Aortic insufficiency is readily demonstrated by supravalvular aortic injections. The amount of contrast agent so injected which reaches the ventricular cavity provides a useful guide to the severity of the defect.

Fig. 8. Aortic arch ring anomaly in a 17-year-old male (St. Joseph's Hospital case). The anteroposterior view with contrast substance injected into the left aortic arch reveals the presence of a right descending aorta and ligamentum arteriosum. Other projections confirm this.

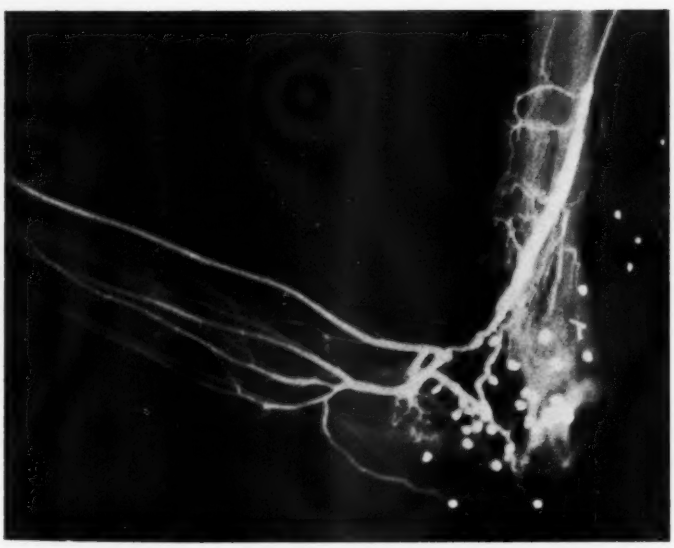

Fig. 9. Gunshot wound of right elbow (St. Joseph's Hospital case). Contrast material injected into the right brachial artery following percutaneous introduction at the level of the axillary artery reveals irregular vascular changes associated with the injury.

Fig. 10. Renal arteriography with demonstration of small renal cyst in a 32-year-old male (VOMS 27–58–44). Fluoroscopy was not needed, the tubing having been introduced and advanced a distance estimated to be appropriate. Films sequentially obtained during renal arterial and parenchymal opacification. Bilateral double renal arteries are present. The spermatic arteries are demonstrated. Best shown in D (arrows) is a 1-cm. subcortical renal cyst. As might be inferred from the distribution of contrast substance, the examination was performed with the patient in supine position. Blood-pressure cuffs were used on both legs.

In several instances, open heart surgery, performed because of known ventricular septal defect, resulted in death of the patient due to unrecognized aortic insufficiency (17). Minor aortic regurgitation, though ordinarily of no clinical significance, greatly increases the risk of open heart surgery by allowing reflux of blood into the left ventricle of the arrested heart. Figure 6 illustrates gross aortic insufficiency due to rheumatic valvular disease.

The value of this procedure in demonstrating the anatomic abnormalities responsible for aortic stenosis has been clearly established. Figure 7 presents the appearances caused by (A) congenital subaortic stenosis, (B) supravalvular aortic stenosis (18), (C) acquired aortic stenosis, and (D) congenital aortic stenosis. Valvular aortic stenosis, as might be expected, makes more difficult and, in some instances, has prevented passage of the catheter into the cavity of the left ventricle. Marked supravalvular dilatation of the aorta can also cause trouble by reducing the relative size of the aortic opening.

The diagnosis of lesions of the aortic valve cannot be regarded as complete unless manometric studies are obtained. The nature and extent of pressure gradients confirm the anatomic findings and add much to the pathophysiologic appraisal of the condition under study.

Thoracic Aorta, Coronary and Brachiocephalic Arteries: It has long been recognized that direct intra-aortic injection provides a decisive anatomic diagnosis of patent ductus arteriosus and aortic septal defect. The procedure is also useful in the demonstration of aortic arch anomalies and acquired lesions of the thoracic aorta and its branches (Figs. 8 and 9). Catheterization of the left common carotid and left subclavian arteries is regularly possible, although it is somewhat more difficult to enter the innominate artery. A large volume injected into the aortic arch is capable of furnishing valuable information about intracranial vessels and can provide good opacification of the entire circle of Willis (19).

In modified form, retrograde femoral aortic catheterization provides controlled access to the coronary arteries. Sones (20) demonstrated in a series of 400 consecutive patients, studied without significant morbidity, that direct injection of the coronary orifice furnishes a highly satisfactory means for preoperative localization of coronary occlusive disease. The less traumatic approach of percutaneous arterial catheterization promises to provide a further improvement. Percutaneous guided catheterization is applicable to the use of end-loop catheters (21, 22), and occlusion visualization technics (23, 24).

Abdominal Aorta: For years, translumbar aortography was the procedure of choice for the radiologic demonstration of abnormalities affecting the abdominal aorta and its major branches. In the light of our present experience, we regard this method as a poor second choice. The limitations and risks attendant upon the use of a long needle inserted through the left paraspinal region into the aorta have in the past been regarded as necessary evils. They are no longer necessary. Percutaneous femoral aortography is simpler, less apt to cause discomfort to the patient and, with practice, is a quicker procedure. A large-bore catheter allows the rapid injection rates demanded by the velocity of blood moving through the aorta. With fluoroscopy, precise control of the catheter tip is easily achieved. Ordinarily, it suffices to introduce the catheter a measured distance of 12 to 16 inches without recourse to fluoroscopy, since a rapid injection produces a jet that reaches the descending thoracic aorta and results in good mixing in the aortic stream. Slow injections, especially where tourniquets about the legs are used and in the presence of Valsalva maneuvers, are apt to result in dependent puddling of the contrast agent in the posterior portion of the aorta. This has accounted for visualization of only one kidney, in which instance a second more rapid injection resulted in good mixing and excellent visualization of both renal arterial systems (25). The accuracy with which renal arteriograms

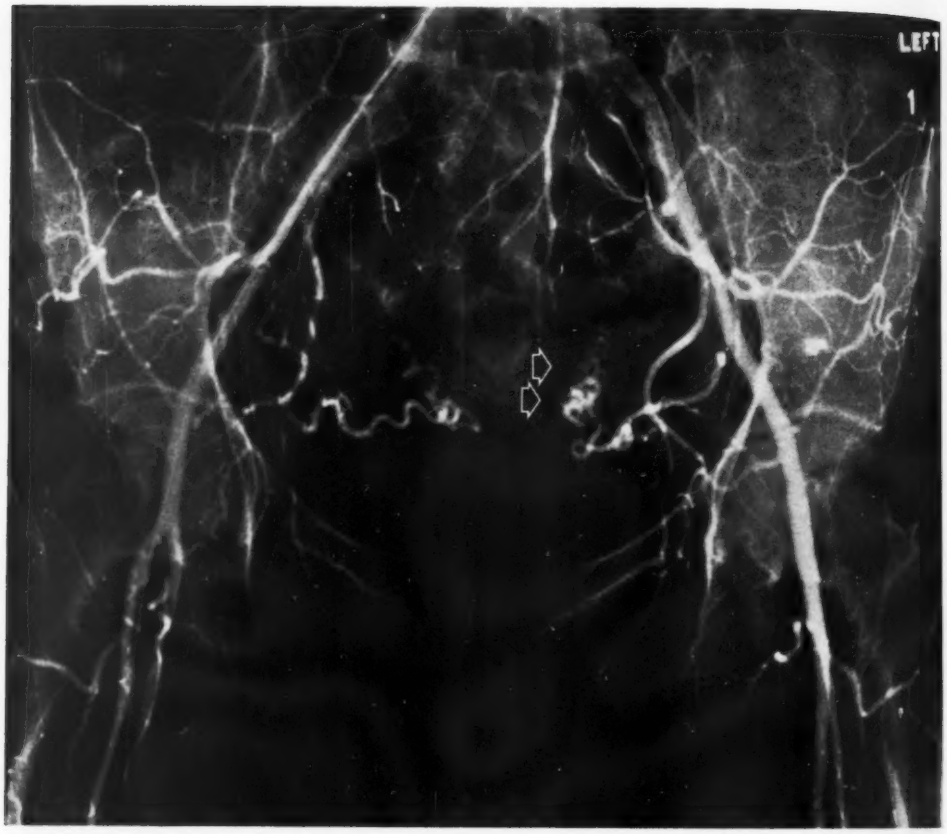

Fig. 11. Arteriography in 47-year-old woman with carcinoma of the cervix (VOMS 11–73–94). Entire examination completed in approximately fifteen minutes. Abnormality in appearance of left uterine arteries proved to be associated with a carcinomatous lesion at the indicated site (arrows). The reliability of this finding remains to be established. In other cases gross dislocation of pelvic arteries indicated the presence of unsuspected intrapelvic extensions of uterine tumors. Delayed films have shown primary opacification of certain lesions.

can be obtained is illustrated in Figure 10, which shows bilateral double renal arteries and, on delayed films, a 1-cm. cyst in the left kidney. The high contrast afforded by rapid injection favors the radiologic demonstration of proximal renal artery narrowing, a surgically correctable cause of hypertension.

Should abdominal aortic occlusion be suspected, it is apparent that the femoral approach is not promising. In such instances, it has been feasible to use the left brachial artery (without surgical exposure).

Pelvic Arteriography: In 3 of our patients the clinical diagnosis of possible placenta praevia was confirmed through the injection of contrast substance at the level of the aortic bifurcation during blood pressure-cuff occlusion of both femoral arteries. Direct filling of placental venous spaces is shown on films exposed at one-second intervals for seven or eight seconds following the injection.

An interesting new approach to the study of uterine cancer is provided in that the technic has, on several occasions, revealed distinct abnormalities in the uterine arteries at the site of known or subsequently identified carcinoma of the uterus or cervix. Figure 11 illustrates such a case. It is of interest that the uterine arteries appear to fill and empty last. Their hypertrophy and displacement associated with pregnancy are well shown by

this technic. In addition to the demonstration of local vascular abnormality in the presence of carcinoma of the cervix, pelvic arteriography has provided useful information concerning lateral pelvic masses causing vascular dislocation.

SUMMARY

Experience gained with percutaneous retrograde arterial catheterization in 157 patients leads to the conclusion that this technic will, in the future, take its place as the method of choice for controlled access to the left ventricle, the aorta, and many of its systemic branches. In the course of time it should, through technical advances, result in development of suitable means for retrograde catheterization of the mitral orifice, an objective of considerable importance. It provides for simple effective radiographic visualization of accessible structures; allows the determination of transaortic valvular pressure gradients, of particular importance in assessing the pathophysiologic significance of aortic stenosis; offers a means for the injection of radiomimetic drugs following the visualization and identification of vessels leading to neoplasms. In providing a means for direct catheterization of the coronary orifices, it not only makes possible detailed coronary artery visualization *in vivo* but also should allow intracoronary administration of fibrinolysin. Perhaps some day a suitable modification in the coil-spring guide will permit "coring" of selected occlusive lesions of the coronary arteries, on an out-patient basis!

Others are encouraged to make use of this valuable approach herein gratefully accredited to Prioton and his co-workers.

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SUMMARIO IN INTERLINGUA

Percutanee Catheterismo Retrograde del Ventriculo Sinistre e del Arterias Systemic

Le experientia ganiate in le studio de 157 patientes con morbo cardiovascular forma le base del presente reporto super percutanee catheterismo retrograde del ventriculo sinistre e del arterias systemic. Le illustrationes hic-juncte demonstra le utilitate del technica in permitter detaliate studios anatomic del ventriculo sinistre, del valvula aortic, del arterias coronari, e del aorta e de su brancas major. Le technica es le technica de election pro le demonstration anatomic de patente ducto arteriose, de coarctation, e de altere anormalitates que interessa le arco aortic. Illo provide medios fidel pro le studio de morbo del valvula aortic e pro le demonstration directe del consequentias hemodynamic de insufficientia mitral. Su valor in arteriographia pelvic, abdominal, cerebral, e peripheric es recognoscite de plus in plus con le crescente familiaritate con illo. Per provider un medio pro le catheterismo directe del orificios coronari, illo non solmente rende possibile un visualisation detaliate del arterias coronari in vivo, sed etiam pote expectar que illo permitte le administration intracoronari de fibrinolysina.

Es presentate detaliate descriptiones del aspectos technic del introduction del agulia, del guidantia de illo, e del tubage polyethylenic usate. Quando le tubage es positionate secundo le plano, le guida es retrahite pro permitter observationes manometric, plethysmographia a impedantia, le collection de specimens de sanguine, e le introduction de agentes radio-opac o de altere drogas.

Duo mortes occurreva in le serie hic reportate, sed—a generalmente parlar—le hasardo del methodo es considerate como grossiermente equal a illo de aortographia retrograde, durante que le morbiditate arterial local associate con aortographia retrograde es absente in illo. Un meticulose heparinisation e bon hemostase post-operatori augmenta le innocentia de percutanee catheterismo retrograde.

Transcarotid Coronary Arteriography in Man with Emphasis on Intercoronary Arterial Anastomosis

WILLIAM MOLNAR, M.D., CHARLES V. MECKSTROTH, M.D., SIDNEY W. NELSON, M.D., and RICHARD W. BOOTH, M.D.

AT THE ANNUAL meeting of the Radiological Society of North America in 1957 we demonstrated the technic and the results of transcarotid aortic valvulography based on a series of 51 injections in 49 patients (1). On that occasion, and in subsequent publications, attention was called to the incidental satisfactory, although inconstant, visualization of the normal coronary arteries in these cases (2, 3). It became evident that, after certain modifications, the method (4) could be utilized for the direct visualization of the coronary arteries in those patients in whom clinical findings and electrocardiography failed to establish a diagnosis. Experimental studies, including approximately 300 injections in 50 mongrel dogs, helped us to introduce the changes in the method necessary for constant detailed visualization of both coronary arteries without increasing the risk associated with thoracic aortography. The results of these experimental studies in animals and the associated electrocardiographic and physiologic changes during and following the injection of contrast material have been discussed separately (5, 6). It is the purpose of this paper to describe the technic of coronary arteriography as used clinically in our institution since 1958, and to demonstrate the radiographic detail obtained in visualization of normal and diseased coronary arteries in 50 patients.

SELECTION OF PATIENTS FOR TRANSCAROTID CORONARY ARTERIOGRAPHY

Selection and preparation of patients for coronary arteriography is important. The disappointing results obtained by other investigators who performed coronary arteriography in old, cachectic individuals (7) and our own previous experiences indicate that the patients should be carefully chosen for the procedure. Inasmuch as most of the candidates for coronary arteriography are between forty and sixty years of age, the cerebral blood circulation should be tested by separate compression of the right and left common carotid arteries for at least ten minutes in the recumbent position. If there is any evidence of carotid or cerebral vascular insufficiency, the transcarotid approach should not be employed. In the presence of a dilated or tortuous innominate artery, the left common carotid artery, rather than the right, should be used for the introduction of the catheter. The presence of a thoracic aortic aneurysm probably increases the risk of cerebral complications. In an earlier series of 26 injections performed to demonstrate aneurysms of the thoracic aorta or of the innominate artery we encountered carotid thrombosis at the site of arteriotomy in 2 cases and temporary hemiparesis in 1, due to cerebral embolus. Although we believe that at least one of these complications can be explained on the basis of our initial technical difficulties, it seems likely that the transcarotid approach is prone to produce cerebral complications in patients with aneurysms. No such complications were encountered when the technic was used for visualization of the coronary arteries, aortic valvular lesions, or congenital anomalies of the thoracic aorta in a total of 109 cases. Inasmuch as all three of the complications occurred in patients over sixty-eight years of age, it is likely that atherosclerosis in this age group is another limiting factor in the selection of candidates

[1] From the Departments of Radiology (W. M., S. W. N.), Thoracic Surgery (C. V. M.), and Cardiology (R. W. B.), The Ohio State University Health Center, Columbus, Ohio. Presented at the Forty-fifth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 15–20, 1959.
This study was supported in part by the Central Ohio Heart Association, Grant 1066.

for transcarotid coronary arteriography. The formation of mediastinal hematomas may be difficult to prevent in patients having hematologic disorders associated with an increased bleeding tendency, and the surgical exposure of the carotid artery is therefore not recommended in such conditions.

In our series of 25 examinations three weeks was the shortest interval between the accident of myocardial infarction and the follow-up coronary arteriography. We observed no adverse effect in the course of the clinical recovery of one patient in whom the procedure was performed within three weeks after he presented the first clinical symptoms of acute coronary occlusion, supported by electrocardiographic findings characteristic of extensive left posterior myocardial infarction. The subsequent coronary arteriograms showed complete obstruction of the secondary branches of the left coronary artery. We believe further investigation is necessary in respect to reaction to the procedures when carried out shortly after the occurrence of coronary occlusion.

RADIOGRAPHIC TECHNIC

It is essential to obtain preliminary films of good quality in respect to contrast and detail before the surgical exposure of the carotid artery. An exposure time of one-thirtieth of a second or less is preferable, with the lowest possible kilovoltage, in order to achieve satisfactory demonstration of the smaller branches of the coronary arteries. Since the patient may change his position in relation to the radiographic device during the surgical part of the procedure, the x-ray field should be marked on the thorax during the preliminary filming. This will make possible a correction in position, if necessary, just before the injection of the contrast material. Unless these simple preliminary procedures are carried out with great accuracy, the final results can be very disappointing.

Filming with simultaneous exposures in anteroposterior and lateral directions is highly desirable for the accurate demonstration of the coronary arteries. Arteriograms taken in a single plane in either projection have their shortcomings. Due to the peculiar course of the coronary vessels, certain segments are either greatly foreshortened in a single view or are overlapped and obscured by the surrounding dense thoracic structures. Thus, in an anteroposterior projection (Fig. 1, A) the contrast-filled descending aorta and the spine usually obscure the early part of the left coronary artery and several of the branches of the right coronary vessel, while the posterior circumflex branch of the left coronary artery is greatly foreshortened. The lateral projection (Fig. 1, B) affords the best visualization of the right coronary artery, including its side branches, which are usually barely detectable on an anteroposterior film. Since, however, the left (main) coronary artery is projected end-on in the lateral view, this would by itself be unsatisfactory in cases in which disease was localized to this segment. The early part of the descending branch of the left coronary artery crosses and is superimposed upon the aortic sinus in this projection and during the injection is usually obscured by contrast material. Nevertheless, this segment can frequently be well demonstrated in the lateral projection on the late serial films, since the coronary vessels usually remain opacified for a fraction of a second longer than the aortic sinus.

If only a single contrast injection is to be made on a single plane angiographic device, the lateral view is to be preferred. The other alternative would be to overcome the disadvantage of the single view by giving two separate injections of 35 to 45 c.c. of contrast material to obtain films in both frontal and lateral projections. In that event, the additional information to be gained by visualization of the coronary arteries in both projections should be carefully weighed against the possible, although remote, risk associated with double injections. It was only two years ago that radioactive Thorotrast was recommended for the visualization of the coronary arteries

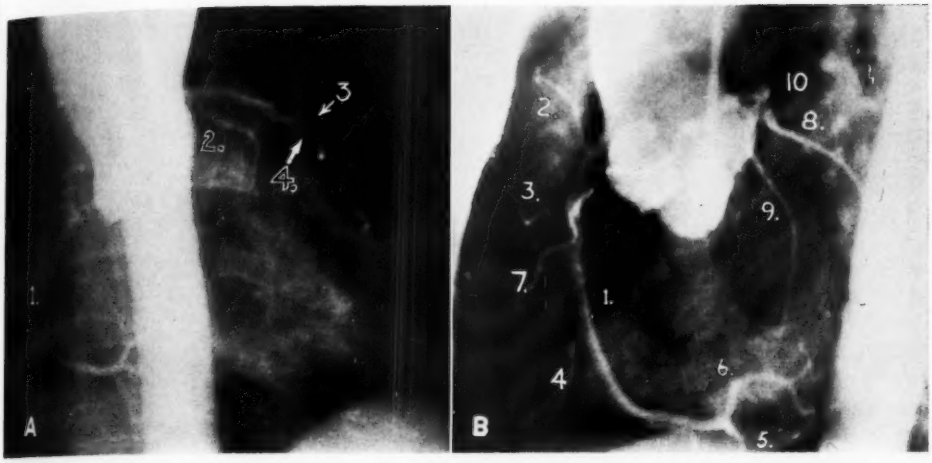


Fig. 1. A. Coronary arteriogram in anteroposterior projection. 1. Right coronary artery. 2–4. Branches of the left coronary artery. 2. Posterior circumflex branch. 3. Anterior descending branch. 4. Branch to the obtuse margin of the heart.

The visualization of the proximal portions of both coronary arteries is limited because of the overlapping contrast-filled aorta and the dense bone structure of the spine.

B. Simultaneously obtained lateral view of the same patient. 1. Right coronary artery. 2–6. Branches originating from the right coronary artery. 2. Conus branch. 3. Branch to the anterior aspect of the right ventricle. 4. Branch to the acute margin. 5. Posterior interventricular branch. 6. Branch to the posterior aspect of the right and left ventricles. 7–9. Branches of the left coronary artery. 7. Anterior descending. 8. Posterior circumflex. 9. Branch to the obtuse margin. 10. Left (main) coronary artery seen end-on in this view.

The extent of visualization of the coronary arterial system in this projection far exceeds the demonstration of these vessels on the simultaneous anteroposterior view (A).

because of the belief that "injection of concentrated organic iodized contrast media into the coronary arteries is prohibitively dangerous" (8). The same investigator has recently found the repeated injection of 35 to 50 c.c. of 90 per cent organic iodized contrast material in a series of levocardiographies to be harmless even with a total dose of 120 to 130 c.c. at the same examination (9). Other workers noted no adverse effect following the injection of 20 to 30 c.c. of concentrated contrast medium directly into the aortic sinus for visualization of the coronary arteries in 50 clinical examinations (10). Even repeated direct injections of 3 to 6 c.c. of concentrated contrast material following catheterization of the right and left coronary arteries produced no complications in 120 patients according to a recent report of these same authors (11).

We have used 90 per cent Hypaque[2] since 1955 in 135 thoracic aortographic examinations and have not observed any major complication which could be directly attributed to the introduction of the medium into the coronary vessels. Two of our patients with advanced coronary arteriosclerosis experienced sudden substernal painful sensations of short duration coinciding with the injection. In one of these the simultaneously recorded electrocardiogram showed depression of the S-T segment and T wave inversion during the painful period. These electrocardiographic changes persisted for several seconds. Our studies were confined to a single injection in all but 3 instances.

SURGICAL TECHNIC AND INJECTION

Local anesthesia is used after administration of 75 mg. of meperidine and 50 mg. of Seconal. Following the surgical exposure of the right common carotid artery, an oval-shaped purse-string suture of No. 5-0 arterial silk is placed around the contemplated site of the tiny longitudinal incision. Umbilical tapes are placed around the artery and traction upon these serves to occlude

[2] Hypaque made available by Winthrop Laboratories, New York 18, N. Y.

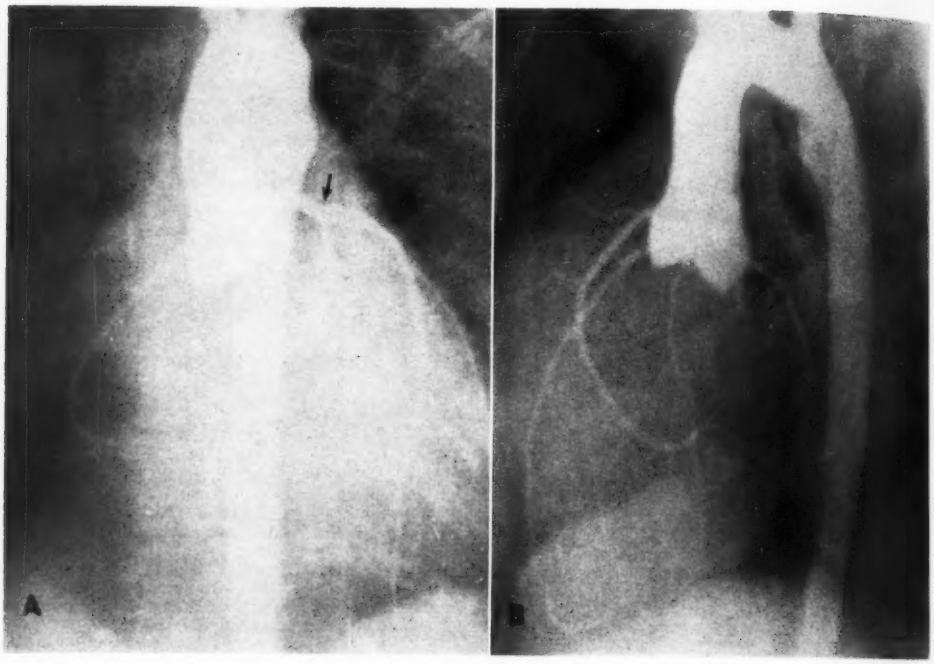


Fig. 2. Case I.

A. Anteroposterior view. The arrow points to the short indentation in the lumen of the left (main) coronary artery.

B. Lateral view. The narrowed segments of the posterior circumflex branch of the left coronary artery are indicated by the arrows. The branch to the acute margin of the heart originating from the right coronary artery is not demonstrated, in spite of the good visualization of the right coronary artery itself.

it for a few seconds during performance of the minute arteriotomy incision through which the catheter is introduced. The traction on the tapes is then released and cerebral blood flow is re-established as indicated by palpable pulsation of the right temporal artery. Since the catheter fits snugly into the incision, no leakage of blood is encountered. This is explained by the fact that the inserted catheter occupies only part of the lumen of the artery. We use a closed-end nylon nonopaque catheter of 3.2 mm. outside diameter and 2.4 mm. inside diameter, with 6 side-holes around the distal 1-cm. segment. We learned during our animal studies that the tip of the catheter can be correctly positioned without fluoroscopy by noting the increased amplitude of the pulsations transmitted to the catheter as it approaches the area of the aortic valve. If there is any doubt in regard to the supravalvular location of the tip, the pressure in the catheter can be checked by means of a strain gauge manometer. After the tip of the catheter is situated in the desired position both carotid arteries are compressed manually while 35 to 40 c.c. of 90 per cent Hypaque is injected with an automatic pressure injector. Simultaneously with the beginning of the injection, films are made at a rate of 4 per second for a total period of four seconds, with the Schönander biplane seriograph. Throughout the procedure the electrocardiogram is observed on an oscilloscope, and a permanent record covering the period of injection is made on a photographic recorder. After the injection is completed, the catheter is removed, the purse-string suture is tied, and the wound is closed. At no time during the examination is the carotid artery completely occluded for more than thirty to sixty seconds. The entire procedure usually requires only fifty to

sixty minutes from skin incision to the closure of the wound, in the hands of an experienced team composed of senior members of the surgery and radiology departments.

RESULTS

The method described above was used in the study of 50 patients. The various radiographic manifestations of coronary arteriosclerosis, including sclerotic plaques, partial or complete obstruction of one or more major coronary arteries, and interesting intercoronary arterial anastomoses associated with complete obstruction, are illustrated in the following reports.

CASE I: I. P., a 33-year-old white female was admitted with hypertension of thirteen years duration. A history of chest pain associated with exertion, but without radiation, was obtained. Physical examination showed a blood pressure of 180/70 mm. Hg in the arm and barely palpable femoral pulses. The blood pressure could not be obtained in the legs. There was a Grade II hypertensive retinopathy and a Grade III systolic murmur was heard over the aortic area. Electrocardiograms showed nonspecific S-T T wave changes and borderline evidence of left ventricular hypertrophy. A glucose tolerance test indicated mild diabetes mellitus.

The aortogram revealed advanced atherosclerotic changes of the abdominal aorta and of the common iliac arteries. Coronary arteriography (Fig. 2) showed short indentations of the lumen of an otherwise patent left coronary artery and of the posterior circumflex branch of the same vessel, the picture being that of typical arterial atheromatous plaques. The right coronary artery and the side branches of this vessel were well demonstrated with the exception of the artery to the acute margin of the heart. (The absence of this artery could be due to a normal variation.)

CASE II: R. G. S., a 36-year-old white male, had proved myocardial infarction eight months prior to admission. Subsequently, persistent angina pectoris and angina decubitus had been present. An electrocardiogram showed changes of an old posterior myocardial infarction. The remainder of the clinical and laboratory studies were within normal limits. Coronary arteriography showed nonfilling of the right coronary artery but good visualization of all the branches of the left coronary artery in the anteroposterior view (Fig. 3, A). The small stump of the occluded right coronary artery was demonstrated only in the lateral projection (Fig. 3,B). In the presence of complete obstruction of the right coronary artery, the right side of the heart must have been supplied with blood by the left coronary artery, thus accounting for the good

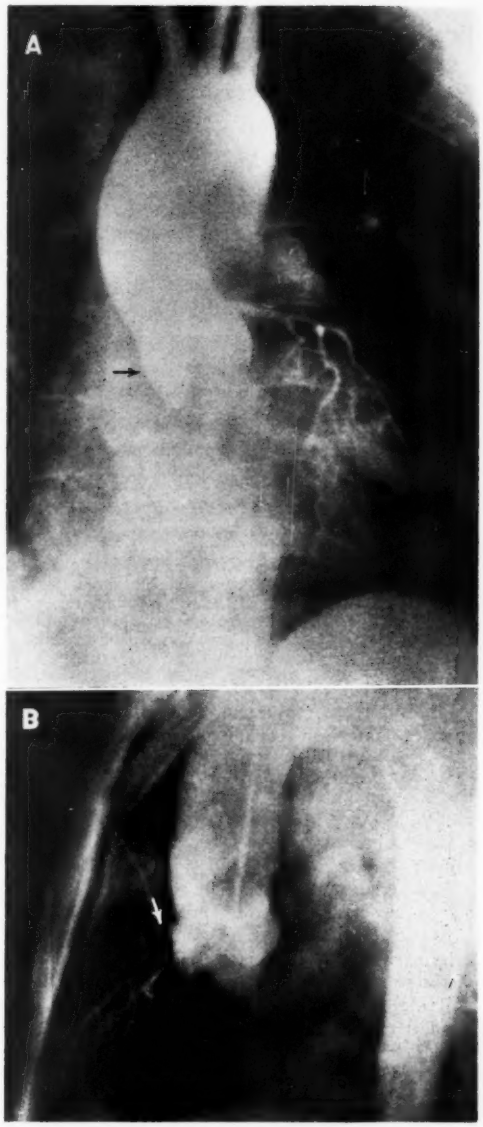


Fig. 3. Case II.

A. Anteroposterior projection. The right coronary artery is not visualized. The arrow points to the right coronary cusp of the aorta. The left coronary artery and its branches are well shown.

B. Lateral projection. The contrast medium fills the branches of the left coronary artery. The short stump of the occluded right coronary artery is indicated by the arrow. The interventricular septum and the anterior aspect of the heart are supplied by an abundant vascular network originating from the anterior descending branch of the left coronary artery.

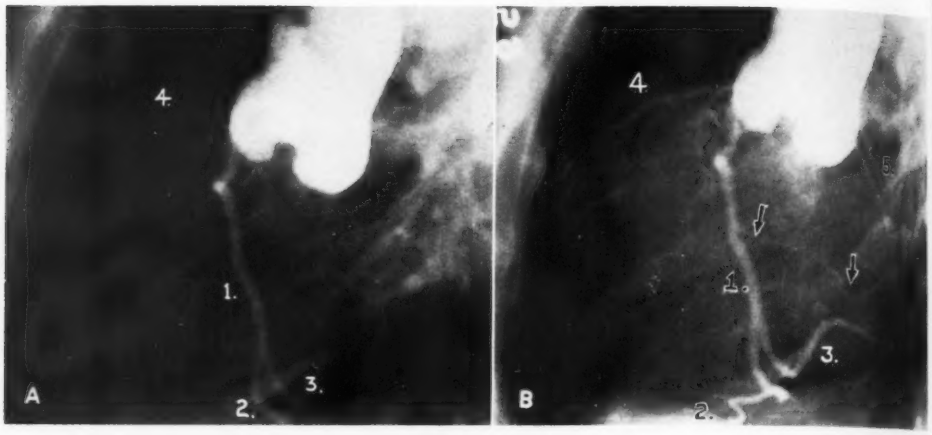


Fig. 4. Case III.

A. Coronary arteriogram in lateral projection showing fixed, stenotic aortic valve with large vegetation. 1. Right coronary artery. 2. Posterior interventricular branch. 3. Branch to the posterior aspect of the ventricles. 4. Anterior descending branch of the left coronary. Notice the absence of filling of the posterior circumflex branch and the branch to the obtuse margin of the heart. Both are branches of the left coronary artery and should fill simultaneously with the anterior descending branch.

B. Later film of Case III. Arrows point to the abnormal branch of the right coronary artery. The branch to the acute margin of the heart, which should arise from the right coronary artery, is absent or not filled. 4. The anterior descending branch of the left coronary artery has a wide lumen and more tertiary branches than are normally seen. 5. The attenuated posterior circumflex branches of the left coronary artery are visualized after a considerable delay. The unusual elevation and anterior displacement of the anterior descending branch of the left coronary are due to the marked left ventricular enlargement and transverse position of the heart.

visualization of the numerous vessels originating from the anterior descending branch of that vessel.

CASE III: E. A. W., a 58-year-old white male, had a documented myocardial infarct one and one-half years prior to admission. There was a history of angina and congestive heart failure. Physical findings of severe aortic stenosis were confirmed by a left atrial puncture which revealed a gradient across the aortic valve of 100 mm. Hg during systole.

Aortic valvulography combined with coronary arteriography was performed as part of the preoperative evaluation to determine the feasibility of valvular surgery. The early serial film taken in the lateral projection (Fig. 4, A) demonstrated excellent filling of the preponderant right coronary artery, with beginning minimal visualization of the anterior descending branch of the left coronary vessel. The posterior circumflex branch and the branch to the obtuse margin of the left coronary artery were not filled. These two branches were first demonstrated as tiny filiform vessels only after complete peripheral filling of the right coronary artery and the anterior descending branch of the left coronary vessel. The arteriogram taken at this particular instant (Fig. 4, B) also demonstrated an abnormal branch of the right coronary artery leading to the posterior aspect of the heart. (The normal right coronary artery has no posteriorly directed side branch in this location.) The late visualization of the two branches of the left coronary artery mentioned above is almost certainly due either to retrograde filling of these arteries through the right coronary vessel or to partial obstruction distal to the orifice of the anterior descending branch with resultant delay in the antegrade filling of the left posterior circumflex artery. The findings in this patient indicate that the site of the partial, or complete, obstruction is in the left posterior circumflex artery at a point proximal to the origin of the branch to the obtuse margin. Unfortunately, our seriographic studies failed to give a clear answer as to whether or not these two branches filled in a retrograde manner.

CASE IV: H. S., a 71-year-old white male, gave a history of a myocardial infarction eleven years previously. About four months prior to admission, progressive dysphagia, subsequently proved to be due to esophageal carcinoma, developed. An electrocardiogram was interpreted as showing changes thought to be due to an old anteroseptal myocardial infarction.

The early serial films of a coronary arteriogram showed almost complete filling of the right coronary artery but no demonstration of the left coronary vessel (Fig. 5, A). In the next film, taken 1.2 second after the beginning of the injection, all of the side branches of the right coronary artery were well outlined. There was also faint beginning visualization of the distal portion of the anterior descending branch and the distal part of the posterior circumflex branch of the left coronary artery (Fig. 5, B). A film at 1.5 seconds showed progression of the retro-

grade flow of the contrast material into the anterior descending and also into the circumflex branches of the left coronary artery (Fig. 5, C). The final film, at 2.4 seconds, demonstrated complete retrograde filling of the anterior descending branch and the left circumflex branches up to the point where preliminary films had shown calcification in the proximal part of the left coronary artery (Fig. 5, D and E).

It appears that this patient probably had had complete obstruction of the left coronary artery for many years. Nevertheless, he managed to survive with the help of anastomotic branches between the right and left coronary arteries. He was seventy-two years old at the time of this examination and was admitted to our center for removal of an esophageal carcinoma. At operation the pericardium was opened. The left coronary artery was palpated and was found to be sclerotic and without palpable pulsation. At the slightest attempt at compression of the first portion of the dilated right coronary artery, the heart went into ventricular fibrillation, which was spontaneously relieved by releasing the compression. The anterior descending branch of the left coronary artery showed impaired pulsation which could be obliterated by compression of the right coronary artery. After successful resection of the mid-portion of the esophagus, the patient returned home. He was readmitted five months later and died after a few days as a result of a left cerebral hemorrhage.

At autopsy, a small aneurysm of the left ventricle was seen in the area of the old myocardial infarction. In order to prove the intercoronary arterial anastomosis, the right coronary artery was injected with Lipiodol under fluoroscopic control. The right coronary artery filled spontaneously and the right side of the heart showed an abundant vascular supply. The attenuated anterior descending branch of the left coronary artery gradually became opacified through the existing anastomotic branches between that vessel and the markedly tortuous branch of the right coronary artery leading to the anterior aspect of the right ventricle. The narrowed branches of the posterior circumflex artery were filled *via* the small arterioles arising from the branch of the right coronary artery supplying the posterior aspect of the right and left ventricles. The lack of filling of the finer ramifications of the left coronary artery is impressive on the radiograph of the specimen taken in a position corresponding approximately to the anteroposterior projection (Fig. 5, F).

At dissection of the heart an organized thrombus was encountered completely obliterating the lumen of the left main coronary artery, with direct extension of the fibrinous plug into the proximal segment of the anterior descending and posterior circumflex branches. The thrombus was slightly adherent to the sclerotic wall of this vessel only at certain points, and it could be removed with ease. The major branches of the artery distal to the occlusion were found to have patent, but narrow, lumina. The old myocardial infarction was located in the anterior-inferior portion of the left ventricle and grossly involved an area 36 × 42 mm. in diameter. There was slight bulging of the myocardium at the site of the infarction.

The antemortem and postmortem radiographic findings in this last patient are interesting in several respects and allow us to draw certain conclusions and make some postulations. Inasmuch as the pathological features observed on the arteriograms were reproduced, even in minor detail, at postmortem perfusion study, and since they were confirmed at the dissection of the coronary arteries, we are convinced that normal or diseased coronary arteries can be demonstrated with accurate detail by the method described. Furthermore, the arteriograms showed the multiple interarterial collaterals between the patent right and the occluded left main coronary artery, findings which were also documented postmortem. Our observations in this case not only prove that survival is possible following complete occlusion of one main coronary artery, but also demonstrate that the extent of the postinfarction myocardial changes may be greatly influenced by the presence or absence of functional collaterals. The great difference in caliber between the right coronary and the attenuated branches of the left coronary artery, which were filled by retrograde flow, is apparent on the arteriograms and also on the radiograph of the heart made following the perfusion. The drop in volume flow and pressure of the arterial blood while it is passing through the precapillary and arteriolar collaterals in retrograde fashion is probably significant enough to explain the "collapsed" appearance of the contrast-filled branches of the occluded left coronary artery. The blood supplied to the left ventricle *via* the right coronary artery, through the existing anastomoses at the time of the occlusion of the left main coronary artery, was apparently adequate for the metabolic need of the major part of the left ventricle. This is suggested by the relatively small myocardial

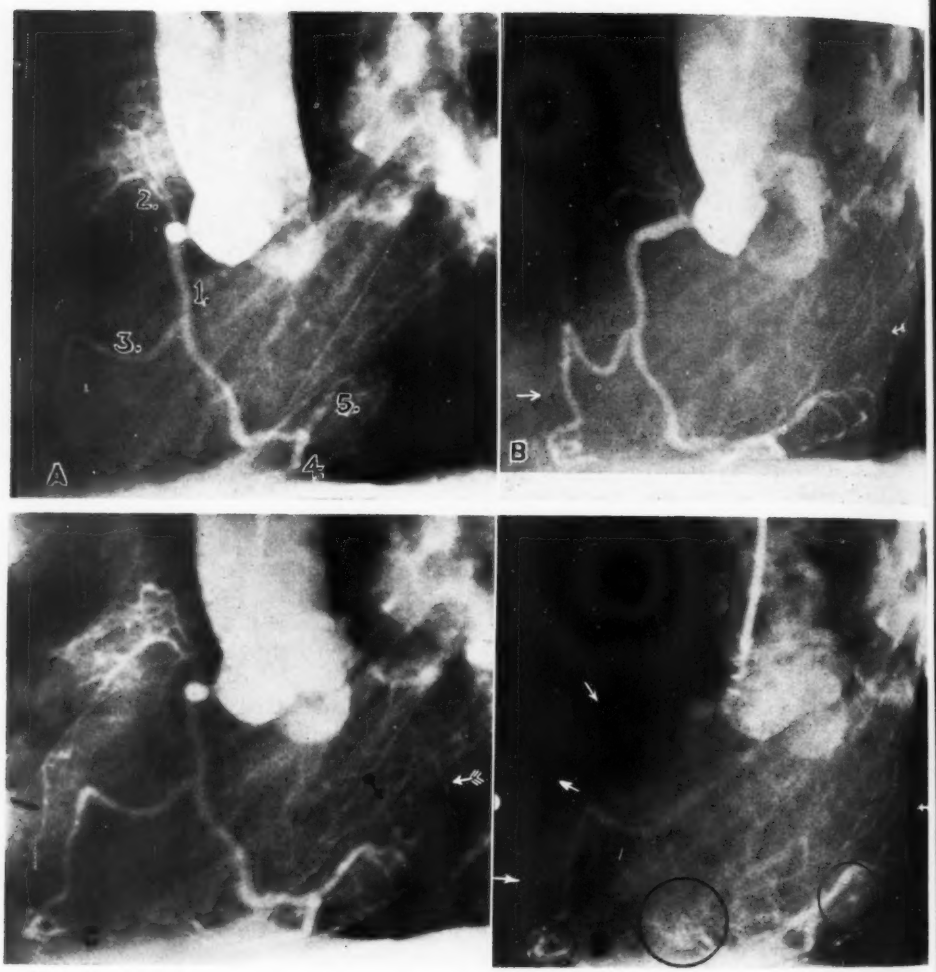


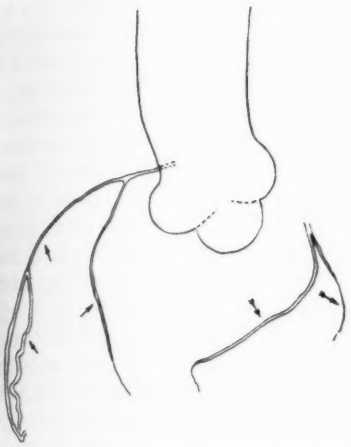
Fig. 5. Case IV.

A. Coronary arteriogram in lateral projection taken 0.06 second after the beginning of the injection. Filling of the right coronary artery is prompt, but absent in the left coronary artery. 1. Right coronary artery. 2. The artery to the pulmonary conus and the branch to the anterior aspect of the right ventricle arising by a common stem from the right coronary artery. 3. Branch to the acute margin of the heart. 4. Branch to the posterior interventricular sulcus. 5. Branch to the posterior aspect of the left and right ventricles.

B. Serial angiogram at 1.2 seconds, showing further peripheral filling of the right coronary artery. The arrows point to the very faint beginning opacification of the distal portion of the anterior descending (→) and the circumflex branches of the left coronary artery (←●). Notice that the peripheral segments are filled, although there is no evidence of filling of the proximal portion of the left coronary artery or its branches! This is evidence of retrograde filling.

C. Lateral view taken at 1.5 seconds. There is further retrograde flow of the contrast medium outlining a longer segment of the anterior descending (←) and circumflex branches of the left coronary artery (●→).

D. Serial film, 2.4 seconds after the beginning of the injection of contrast material. The right coronary artery is still faintly visualized. The attenuated branches of the left coronary artery are fully demonstrated at this time. (Part of the anterior descending branch of the left coronary artery is retouched for better visualization.) The ill-defined collections of contrast material in the three encircled areas represent the numerous collaterals between the following branches of the two coronary arteries: branch to the acute margin of the right—anterior descending ramus of the left (circle at the left), posterior interventricular of the right—septal branch of the left anterior descending (middle circle), and ramifications of the right coronary artery supplying the posterior aspect of the ventricles—the posterior circumflex of the left coronary artery (circle on the right).



E. Fig. 5, E. Drawing showing segments of the anterior descending (→) and posterior circumflex branches (■→) of the left coronary artery which became gradually opacified on the serial films by the retrograde flow of the contrast material.

F. Fig. 5, F. Radiograph of the heart specimen in anteroposterior projection following perfusion of the right coronary artery with Lipiodol. Note abundant vascularization of right side of heart in contrast to left. 1. Right coronary artery. 2–4. Branches originating from the right coronary artery. 2. Branch to the acute margin of the heart. 3. Branch to the posterior interventricular sulcus. 4. Final ramifications of the right coronary artery to the posterior aspect of the right and left ventricle. The arrows point to the anterior descending (←) and posterior circumflex branches (←■) of the left coronary artery filled by contrast material through the network of interarterial anastomoses, demonstrated here between the branches of the patent right and occluded left coronary arteries (circled areas).

Figs. 5, A-E, illustrating Case IV, were discussed at the Ninth International Congress of Radiology, Munich, 1959.

infarction found postmortem in spite of the complete occlusion of the left (main) coronary artery. Since the patient had had no angina or significant cardiac symptoms, one may even postulate that there was further development of these collaterals after the infarction in order to satisfy the functional requirements of the left ventricle.

DISCUSSION

Results of the clinical application of coronary arteriography to the visualization and diagnosis of coronary arterial sclerosis have been published by several investigators during the last few years. Thal described the findings in 50 examinations in which the catheter was introduced either by way of the brachial or the femoral artery (12). Lemmon reported on 31 patients in whom he had used a suprasternal percutaneous puncture for the injection of the contrast medium into the proximal part of the ascending aorta (13). Recently Dotter mentioned the clinical application of his method requiring induced cardiac arrest in combination with aortic occlusion for the visualization of the coronary arteries in one patient with a fatal outcome (14).

Our clinical investigation is based on 50 consecutive injections of 35 to 45 c.c. of 90 per cent Hypaque into the aortic sinus to visualize the coronary arteries, by the transcarotid technic. Three additional cases in which only the surgical part of the procedure was attempted by operators unfamiliar with the technic are not included in this series. These 50 patients were subdivided into two groups on the basis of the history and clinical findings. The first 25 were candidates for heart surgery, because of suspected combined aortic and mitral valvu-

lar disease. They had neither symptoms nor clinical findings indicating coronary arteriosclerosis. These patients served as a control group to establish a base line in regard to the anatomical detail and extent of filling of the normal coronary arteries to be expected following the application of the technic. The second group of 25 patients had either electrocardiographic findings characteristic of or consistent with coronary disease, or clinical symptoms of angina with or without a history of previous myocardial infarction. The findings on the coronary arteriograms in these two groups are summarized in Table I.

COMPARISON OF CORONARY DETAIL IN 25 PATIENTS WITH NORMAL EKG AND 24 WITH ABNORMAL EKG

INDICATION	NO. INJ.	NO. SUCC.	NO. + EKG	RT. MAIN	RT. SEC.	RT. TERT.	LT. MAIN	LT. SEC.	LT. TERT.
VALVULAR DISEASE	25	25	0	25	25	24	25	25	24
CORONARY ARTERY DISEASE	25	23	24	23	18	14	20	17	11

Table I. Abbreviations: No. Inj.: Number of injections. No. Succ.: Number of successful injections. No. +EKG: Number of patients with electrocardiographic findings indicative of coronary artery disease. Rt. Main: Right coronary artery. Rt. Sec.: Right secondary branches. Rt. Tert.: Right tertiary branches. Lt. Main: Left coronary artery. Lt. Sec.: Left secondary branches. Lt. Tert.: Left tertiary branches.

The patients in the group with "valvular disease" consistently showed visualization of both coronary arteries including the secondary and tertiary branches, with a single exception in which the tertiary branches were not demonstrated. The uniformly high quality of anatomical detail obtained in this "normal" group made it seem likely that the same method would afford accurate demonstration of the pathologic conditions in cases of diseased coronary arteries. One of the patients in the group having "coronary artery disease" had only clinical symptoms of angina with normal electrocardiographic findings. There were 2 unsuccessful injections in this group. In 1 patient the tip of the catheter slipped inadvertently into the left ventricle and a levocardiogram was obtained following injection. In the second unsuccessful case the injection was carried out while the catheter was located in the descending aorta. The coronary arteriograms in this group of 25 patients showed that the early portion of the left coronary artery was completely occluded in 3 patients, whereas 2 patients had obstructions within the first 1-cm. segment of the right coronary artery. Definitive intercoronary arterial anastomosis was demonstrated in 1 of these 5 patients and was strongly suggested in another.

The long-accepted concept that the coronary vessels represent true end-arteries was challenged seriously by the investigations of Gross (15), Spalteholz (16), and Campbell (17). On the basis of their studies it was gradually realized that anastomotic circulation between the coronary arteries may develop with advancing age. Blumgart, Schlesinger, and Davis (18) studied extensively and in great detail the radiographic appearance of the diseased coronary arteries in a series of 125 autopsies. They concluded that, while the anastomotic branches in the normal human heart are less than 40 micra in diameter, coronary arterial "occlusion regularly results in the development of the intercoronary anastomosis measuring 200 to 400 micra in diameter. . . . Anastomotic circulation develops, then, only when and where it is needed."

The idea that the communicating precapillary branches of such small caliber (less than 40 micra in diameter) could become sufficiently enlarged to supply a significant amount of blood through anastomoses to the infarcted area in the case of sudden obstruction of a coronary artery met with skepticism (19). Later Ravin and Geever demonstrated, on the basis of their perfusion studies of the coronary arteries in 166 hearts, that interarterial anastomoses occur more frequently in normal hearts than in hearts with coronary arterial sclerosis (20). Laurie and Woods performed 150 successful perfusions of the coronary arteries in Bantu patients after autopsy (21). They found functionally significant anastomoses in

75 per cent of the normal hearts in subjects over four years of age, but in only 23 per cent of the hearts in patients with chronic ischemic heart disease. Their findings seem to indicate that functionally important intercoronary arterial communications exist in a significant number of normal human hearts. These anastomotic channels may either prevent the incidence of myocardial infarction in the case of sudden coronary occlusion or they may become slowly dilated in patients in whom the coronary artery becomes gradually occluded. It is fair to assume that most of the patients with long survival following myocardial infarction have a substantial blood supply either from the opposite coronary artery or from the same coronary artery through a branch originating proximal to the occlusion. There is probably an important relation between inherited arterial anastomoses and survival in cases of coronary occlusion.

CONCLUSION

1. A technic of transcarotid coronary arteriography is presented. Consistent visualization of both coronary arteries was obtained with good anatomical detail in a series of 50 clinical cases.

2. Characteristic arteriographic features of diseased coronary arteries in man have been demonstrated: for example, narrowing, obstruction of the lumen, and intercoronary arterial anastomoses in cases of complete obstruction.

3. The significance of inherited intercoronary arterial anastomoses in patients with coronary occlusion is emphasized.

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SUMMARIO IN INTERLINGUA

Arteriographia Coronari Transcarotic in Humanos, con Attention Special Prestate a Anastomose Intercoronario-Arterial

Es describite le technica de arteriographia coronari transcarotic. Visualisation de ambe arterias coronari esseva obtenite uniformemente, con bon detalio anatomic, in un serie de 50 casos clinic.

Le meticulose selection del patientes es essential. Si ulle signo de insufficientia carotic o cerebro-vascular es presente, le via de accesso transcarotic non deberea esser usate. Le presentia de aneurysmo del aorta thoracic, de atherosclerosis, o de morbo hematologic associate con un augmento del tendentia sanguinatori augmenta le risco de complicationes.

Le obtention de expositiones simultanee in direction anteroposterior e lateral es altemente desirabile pro le accurate demonstration del arterias coronari, sed si solmente un injection de substantia de contrasto pote esser effectuate con dispositiones pro un plano unic, le exposition lateral debe esser preferite.

Le varie manifestationes radiographic de morbo de arteria corinari—incluse placas sclerotic, obstruction partial o complete de un o plure major arterias coronari, e anastomose intercoronario-arterial associate con obstruction complete—es illustrate per 4 reportos de casos.

Es sublineate le importantia de anastomoses intercoronario-arterial de origine hereditari in patientes con occlusion coronari. Il pare plausibile supponer que le majoritate del patientes con prolongate superviventias post infarcimento myocardial deriva un considerabile provision de sanguine ab le arteria coronari contralateral o ab le afficite arteria cornari via un branca que prende su origine in un puncto proximal con respecto al sito del occlusion. Il existe probabilemente un importante relation inter congenite anastomoses arterial e longevitate in casos de occlusion coronari.

Complications of Selective Angiocardiography[1]

THEODORE F. HILBISH, M.D., and JEAN R. L. HERDT, M.D.

WITH THE RAPID development of surgical procedures for the treatment of congenital and acquired cardiovascular defects, the need for more precise radiographic methods for the anatomical demonstration of the cardiovascular system has become increasingly apparent. This need has prompted a continuing improvement in contrast media, radiographic equipment, and injection technics, and has led to our present methods of selective angiocardiography. Since the introduction in 1933 by Chavez *et al.* (1) of direct intracardiac injection of contrast material, and the report in 1949 by Jönsson and his coworkers (5) of a technic of selective intracardiac injection by catheter, thousands of selective angiocardiographic examinations have been performed. As additional experience has been gained, some of the complications of this radiographic procedure have been recognized, and occasional reports have been published describing specific examples. A search of the literature, however, failed to reveal any *comprehensive* discussion of this subject.

The purpose of this presentation is to review our experience at the Clinical Center, National Institutes of Health, with complications resulting from the performance of 250 selective angiocardiographic studies. All injections of contrast media were made *via* intravascular or intracardiac catheter with the use of a Gidlund power injection apparatus. Aortography and other intra-arterial injections (except for the pulmonary artery) are not included in this study. Table I portrays the frequency and sites of injection. The technic used for selective angiocardiography has been described in a previous publication (4).

TABLE I: SITES AND NUMBER OF INJECTIONS OF CONTRAST MEDIUM

Intracardiac		Intravascular	
Right ventricle	158	Pulmonary artery	29
Left ventricle	45	Inferior vena cava	2
Common ventricle	3	Superior vena cava	1
Right atrium	9		
Left atrium	3		
TOTAL	218	TOTAL	32

The inadvertent injection of a small quantity of 70 per cent Urokon into the myocardium of one of our patients led to a search of the literature for more data on this subject. This, in turn, prompted the realization that more information was needed concerning the complications of selective angiocardiography. Upon reviewing our results, it appeared that the complications in our series could be divided into three broad and somewhat overlapping categories, *i.e.*, mechanical, clinical, and radiological. We regard as mechanical those complications resulting from the failure of the x-ray equipment or other apparatus used in the course of the examination. Clinical complications were defined as the minor or major objective reactions of the patient to the procedure. Since our technic calls for the injection of contrast material under intravenous anesthesia, the flushing, burning, nausea and vomiting, and the sensation of heat experienced by the nonanesthetized are not recorded. Those complications which are recognized solely or primarily by their roentgen appearance, we choose to call radiological complications.

MECHANICAL COMPLICATIONS

Mechanical complications include those technical difficulties arising from malfunction of the film-changing equipment, failure of injecting apparatus, overloading of x-ray tubes, catheter recoil during

[1] From the Diagnostic X-ray Department (T. F. H., Chief; J. R. L. H., Resident in Radiology), Clinical Center, National Institutes of Health, Bethesda, Md. Presented at the Forty-fifth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 15–20, 1959.

injection, and physical defects of the catheter. The Schönander biplane radiographic unit is used at the Clinical Center and, in the majority of studies, 6 films per second are obtained in two planes simultaneously. Early in our experience with this unit we encountered film-jamming, sticking of films along the passageways, and occasional microswitch failure. By adhering to a strict regimen of cleaning the intensifying screens after each examination, by installing magnetic film guides, by careful loading of the films, and by double-checking the microswitches before injection, we have been able to eliminate most of the mechanical complications resulting from malfunction of the x-ray apparatus.

The problem of backlash of the catheter within the heart during injection has been largely resolved by the replacement of the open-end catheters used early in our studies by a modified Lehman catheter with a closed end and four small side-wall openings proximal to the tip. The walls of this modified catheter are thin but strong, thereby eliminating the occasional catheter rupture previously experienced during high-pressure injections.

CLINICAL COMPLICATIONS

The "clinical" complications observed during this study are listed in Table II.

TABLE II: CLINICAL COMPLICATIONS OBSERVED IN PERFORMANCE OF 250 SELECTIVE ANGIOCARDIOGRAPHIC STUDIES

Type of Complication	No. Cases	Per Cent
Allergic reactions	5	2.0
Pulmonary infarction	2	0.8
Inflammatory reaction	2	0.8
Hypotension	2	0.8
Arterial spasm	2	0.8
Death	1	0.4
Cardiac tamponade	1	0.4
Respiratory arrest	1	0.4
Ventricular fibrillation	1	0.4
Grand mal seizure	1	0.4
Hemiplegia	1	0.4

The most important of these will be discussed briefly but the less significant ones will be mentioned only.

A Negro male of four and a half months, with complete transposition of the great vessels, died eight hours after cardiac catheterization, nitrous oxide tests, and selective angiocardiography. Following the radiographic procedures, the patient was awake and crying but subsequently lapsed into a semicomatose state and failed to respond to resuscitative efforts. At autopsy, the diagnosis was substantiated but the direct cause of death was not discovered. It is well known that patients with severe cyanotic heart disease may die at any time; hence the role of selective angiocardiography in this instance is difficult to evaluate.

Cardiac arrhythmias occur frequently in selective angiocardiography. Zinn *et al.* (9) have attributed the electrocardiographic changes during and following injection of an intracardiac contrast agent to increased permeability of vessel walls with associated excessive myocardial irritability and ectopic foci. However, abnormal rhythms reportedly (7) occur in over one-third of all patients undergoing right heart catheterization alone, without injection of contrast media. In our study, the majority of patients had some type of arrhythmia—the most common of which was ventricular extrasystoles. Short runs of nodal rhythm, auricular fibrillation, bundle branch block, and momentary cardiac standstills not infrequently appeared. In one patient ventricular fibrillation developed, requiring immediate emergency thoracotomy and defibrillation as a life-saving measure.

Pulmonary infarction occurred in 2 patients—one with massive infarction of the right lung, and the other with segmental infarction of the left upper lobe. Typical symptoms with hemoptysis, shock, and dyspnea developed in these patients; both eventually recovered.

In another patient, four hours after the intracardiac injection of the contrast material, pulmonary and cardiac arrest developed following nausea and vomiting. Apparently this was secondary to aspiration. The patient responded to suction, artificial respiration, and external stimuli, with an uneventful recovery.

Perforation of the heart with injection of contrast material into the pericardium occurred in 1 patient (Case VII), with subsequent development of cardiac tamponade. Prompt surgical intervention resulted in recovery without apparent sequelae.

A right hemiparesis, cortical blindness, and bilateral deafness followed right ventricular angiocardiography in a 2-year-old white female with severe cyanosis due to a tetralogy of Fallot. Subsequent performance of a Blalock-Taussig anastomosis resulted in some relief of cardiac symptoms, but the neurologic symptoms persisted. The central nervous system complications were attributed to thrombosis of the left cerebral artery—always a potential hazard in patients of this type.

Sensitivity to the new opaque media is seldom observed, but in one patient selective angiocardiography was cancelled because of the appearance of electrocardiographic evidence (severe S-T depression) of adverse reaction to a test dose of 70 per cent Urokon. Allergic responses of lesser importance included the development in 2 patients of a moderately severe generalized urticaria; another showed a transitory petechial rash, and a fourth experienced an abrupt febrile response immediately following injection, which subsided within twenty-four hours.

Other clinical complications encountered in our experience are listed in Table II. All complications which are specified in the table but not discussed terminated in recovery without significant sequelae.

RADIOLOGICAL COMPLICATIONS

The most common roentgen complication observed was extravasation of contrast material into the myocardium. This was seen in approximately 6 per cent of all cases of intracardiac injection.

Penetration of the myocardium by the intracardiac catheter was visualized radiographically in 3 cases and perforation of a presumed intact ventricular septum was recorded in another. With the exception of 1 case, previously mentioned, in which the major portion of the injected contrast medium was introduced into the pericardial sac, no adverse clinical reactions were observed other than transitory cardiac arrhythmias.

Venous and/or lymphatic drainage of contrast material from the myocardium was observed in 5 patients. Extravasation of the agent occurred in 10 additional cases, but the quantity was so small that the route of dispersal could not be identified. No subjective or objective abnormalities other than transitory arrhythmia and the x-ray findings were recorded in these instances.

The inadvertent injection of a small quantity of air rather than 70 per cent Urokon into the left ventricle was visualized radiographically in 1 case. In another, 65 c.c. of 70 per cent Urokon was unintentionally injected into the right main pulmonary artery, producing radiographic changes which will be discussed later.

ILLUSTRATIVE CASES

The following cases have been selected to demonstrate the various radiological complications encountered in this study.

CASE I: J. S., a white male, age 2, was admitted to the Clinical Center for evaluation of acyanotic heart disease. Clinical and laboratory studies led to a diagnosis of left-to-right shunts at the atrial and ventricular levels.

A left ventricular angiocardiogram (Fig. 1) demonstrated a ventricular septal defect and regurgitation of the contrast material into the left atrium through an incompetent mitral valve. There was extravasation of the contrast material into the myocardium with rapid pickup of the medium by venous channels and return to the right atrium *via* the coronary sinus.

Comment: This case demonstrates the immediate dispersal of the contrast agent from the myocardium through venous channels. The patient experienced no untoward effects from extravasation of the 70 per cent Urokon into the left ventricular wall.

CASE II: C. B., a 46-year-old white male, was admitted because of shortness of breath of six years duration. The history, together with clinical and laboratory findings, led to a diagnosis of rheumatic heart disease with calcific aortic stenosis. Per-

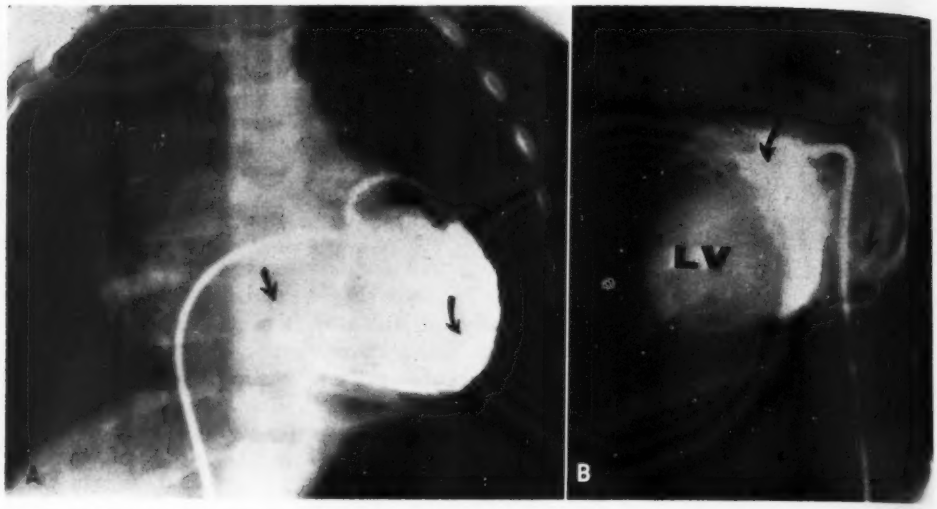

Fig. 1. Case I. A. Anteroposterior angiocardiogram demonstrating extravasation into wall of the left ventricle (curved arrow), with return of the contrast substance by cardiac veins and emptying into the right atrium at the coronary sinus (straight arrow).

B. Lateral angiocardiogram showing contrast material in wall of the left ventricle (curved arrow) and its return by coronary sinus (straight arrow).

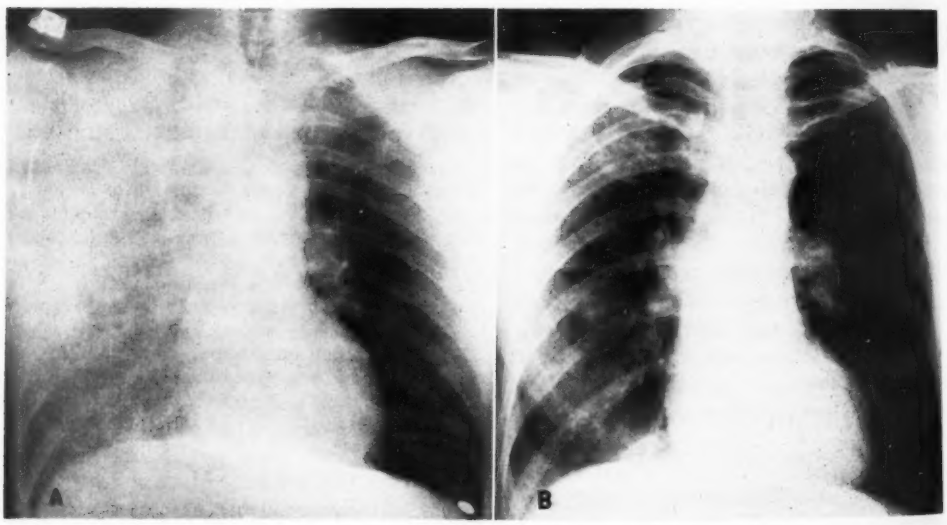

Fig. 2. Case II. A. Postero-anterior chest film demonstrating infarction of the right lung, with extensive opacification.

B. Chest film obtained nine days later, showing marked clearing of pulmonary infarction, with some residual opacification, especially in the right upper lobe.

formance of selective angiocardiography with the tip of the catheter in the right main pulmonary artery resulted in an immediate clinical reaction following injection.

During fluoroscopy, the tip of the catheter was observed lying in the pulmonary artery to the right lower lobe. The catheter was then withdrawn approximately 3 inches before injection of Urokon but its final position was not determined by a scout film obtained immediately prior to injection. Unfortunately, at the time of injection, the catheter tip was still in the main pulmonary artery, and 65

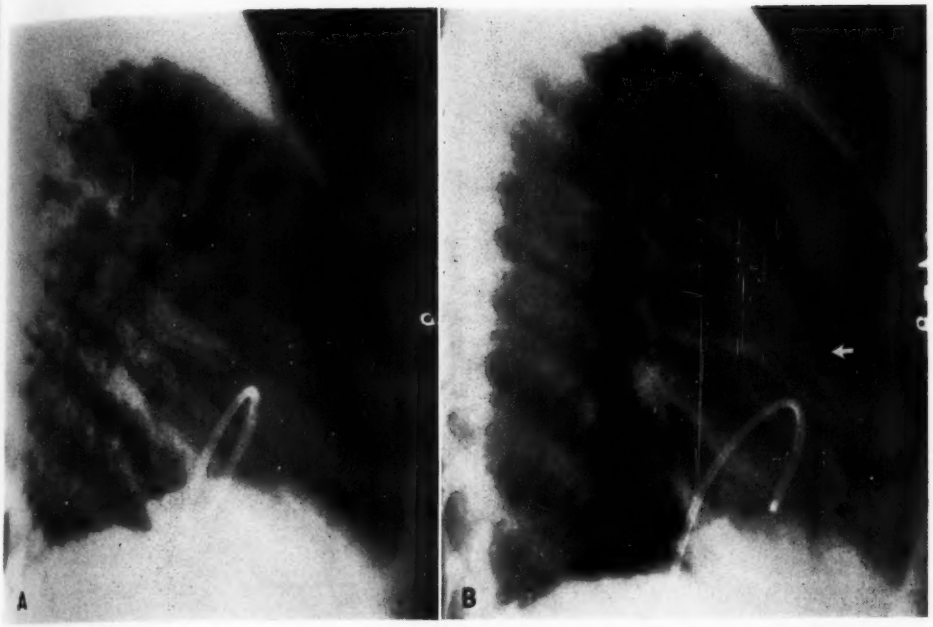

Fig. 3. Case III. A. Lateral scout film showing intracardiac catheter located at the apex of the left ventricle. B. Lateral film obtained after the injection of 13 c.c. of air. Note air in the left ventricle (black arrow) as well as air in the outflow tract of the left ventricle and base of the pulmonary artery (white arrow).

c.c. of 70 per cent Urokon was injected directly into that vessel. There were immediate symptoms of pulmonary infarction with shock, hemoptysis, and dyspnea. A chest film (Fig. 2, A) demonstrated opacification of the entire right lung—most marked in the right upper lobe. A subsequent chest film (Fig. 2, B) nine days later, showed considerable clearing of the pulmonary infarction. Hemoptysis persisted for ten days, but the patient made an uneventful recovery.

Comment: Following this experience, scout films have been obtained of all patients, immediately prior to injection of the contrast material.

CASE III: G. S., a white male, age 5, was admitted to the hospital with a diagnosis of transposition of the great vessels. A selective angiocardiogram was obtained in the usual manner, with the tip of the catheter located at the apex of the left ventricle (Fig. 3, A). Because of a leak in the power-injecting equipment, 13 c.c. of air was inadvertently injected instead of the contrast material (Fig. 3, B). The patient withstood the injection well and there was no demonstrable change in the electrocardiographic tracings. There was some delay in awakening from anesthesia, but vital signs remained stable and subsequent neurological study demonstrated no adverse effects. After three days

Fig. 4. Case IV. Lateral angiocardiogram showing stenotic pulmonary valve (P S.), hypertrophy of the musculature of the outflow tract of the right ventricle (small arrow), and extravasation of contrast material in the subepicardial area (superior arrow). The curved arrow delineates the catheter tip.

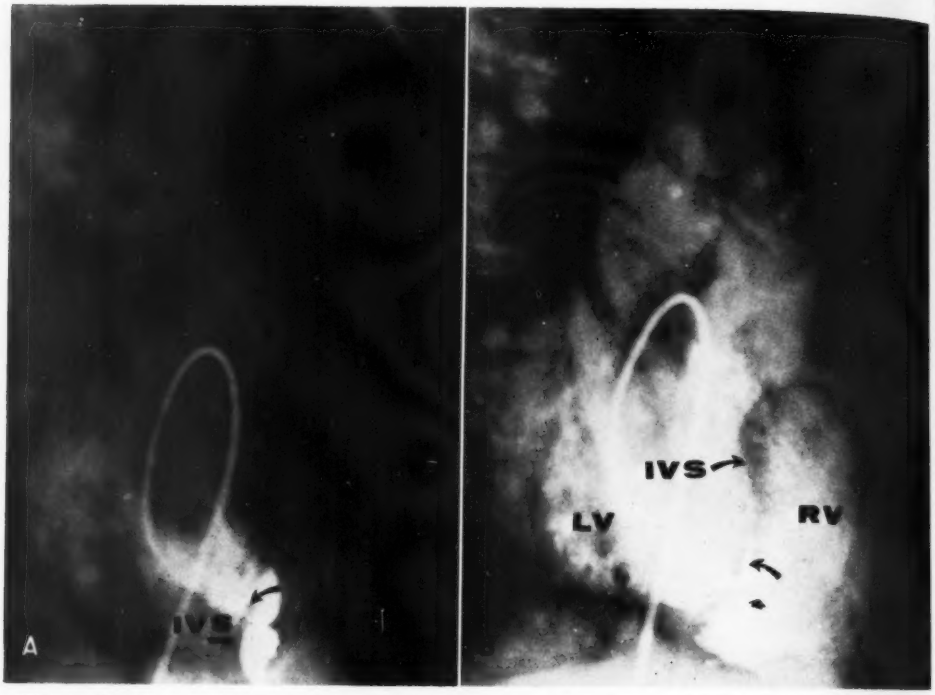

Fig. 5. Case V. A. Lateral angiocardiogram with the catheter tip penetrating the ventricular septum (curved arrow). Contrast medium is visualized in both the right and left ventricles. The interventricular septum is designated by the straight arrow.

B. Lateral angiocardiogram taken later in sequence. Contrast medium has extravasated into the interventricular septum (curved arrow), with the catheter tip now seen well within the right ventricle (straight arrow). (LV. Left ventricle. RV. Right ventricle. IVS. Interventricular septum.)

of observation, the patient was discharged without sequelae to return in three to six months for further study.

Comment: The injection of air instead of 70 per cent Urokon was the result of omission of a final check of the power syringe to make certain that the contrast material was in proper position. Fortunately in this case, because of transposition of the great vessels, the major portion of the air entered the pulmonary rather than the cerebral circulation; hence the lack of clinical reaction.

CASE IV: E. H., a 37-year-old white female, was admitted to the Clinical Center with a history of a cardiac murmur since the age of three. Clinical and radiographic studies led to a diagnosis of pulmonic stenosis.

Selective angiocardiography, with injection of 45 c.c. of 70 per cent Urokon into the right ventricle, demonstrated a fixed and thickened pulmonic valve. There was extravasation of the contrast material into the anterior wall of the myocardium and through the anterior wall into the subepicardial area of the heart (Fig. 4).

Comment: This case is illustrative of passage of contrast material through the myocardium of the anterior wall of the right ventricle. The Urokon spread out beneath the visceral pericardium, obviously extending beyond the confines of the cardiac musculature. It is also to be noted that the catheter tip penetrated almost through the myocardium. Interestingly enough, this patient experienced no adverse reaction to the injection.

CASE V: M. P., a 56-year-old white female, was admitted to the hospital with exertional dyspnea. Clinical, laboratory, and radiologic findings led to a diagnosis of an atrial septal defect. There were no laboratory or catheterization data to suggest the presence of a ventricular septal defect.

A selective angiocardiogram demonstrated gross mitral insufficiency, a large atrial septal defect, and a small ventricular septal defect near the apex (Fig. 5).

Comment: It is probable that the ventricular septal defect resulted from penetration of the septum by the catheter. Extravasation of contrast material into the ventricular septum suggested this possibility. The complete lack of evidence of a ventricular septal defect prior to the radiographic examination further substantiates the impression that the defect was iatrogenic.

CASE VI: T. P., a white male, age 8, was admitted to the Clinical Center with a history of cyanosis since birth and a diagnosis of tetralogy of Fallot. A Blalock-Taussig procedure in 1951 afforded temporary relief.

Selective angiocardiography demonstrated a tetralogy of Fallot as well as a patent Blalock-Taussig shunt on the right (Fig. 6). There were extravasation of the contrast material into the anterior wall of the right ventricle and pick-up of the Urokon by lymphatic channels leading to the superior mediastinum.

Comment: This case is included in the illustrative group because of the unusual route of dispersion of the contrast agent from the myocardium.

CASE VII: D. E., a white Air Force pilot, age 37, was admitted to the Clinical Center with a tentative diagnosis of rheumatic valvulitis and mitral insufficiency. Although he had been asymptomatic, electrocardiography had shown increasing left ventricular strain, and a loud systolic murmur was detected.

A selective angiocardiogram demonstrated thickening of the left ventricular wall, with protrusion of the muscle mass into the ventricular cavity (Fig. 7, A). There was also pseudo-narrowing of the outflow tract of the left ventricle due to muscular hypertrophy. The anteroposterior angiocardiogram showed catheter penetration of the ventricular wall, with injection of a considerable quantity of Urokon into the pericardial sac. Opacification of this sac is clearly demonstrated on a subsequent chest film (Fig. 7, B).

Simultaneously with the injection, an electrocardiogram was obtained. This showed four to five minutes of nodal rhythm followed by a spontaneous return to normal sinus rhythm. The patient was carefully observed for the next three hours, by which time there was unequivocal evidence of cardiac tamponade. An emergency thoracotomy was performed, and pericardiectomy was followed by uneventful recovery.

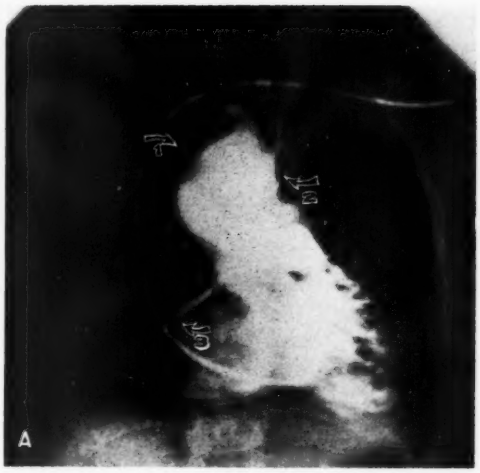

Fig. 6A. Anteroposterior angiocardiogram showing patent Blalock-Taussig anastomosis (arrow 1), lymphatic drainage of contrast material from heart (arrow 2), and visualization of right coronary artery (arrow 3)

Fig. 6B. Lateral angiocardiogram showing lymphatic pickup of contrast material (arrow) from anterior wall of right ventricle, with drainage into superior mediastinum.

Comment: Films in this instance beautifully portrayed intrapericardial extravasation and clearly demonstrated one of the

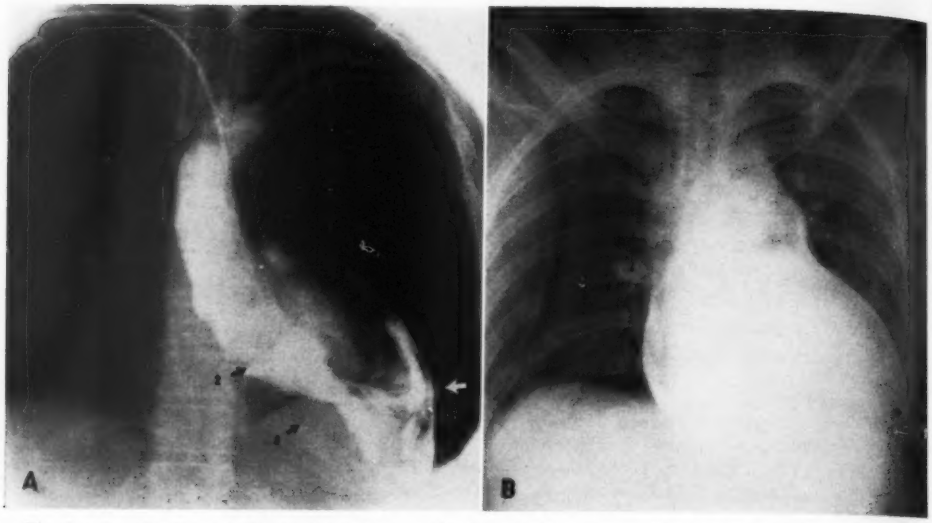

Fig. 7. A. Anteroposterior angiocardiogram showing cathther penetrating into pericardial sac (white arrow), muscular thickening at the level of the mitral valve (arrow 2), and protrusion of thickened myocardium into left ventricular cavity (arrow 3).

B. Anteroposterior chest film demonstrating opacification of cardiac shadow. Note thickness of fluid mixed with Urokon as delineated in pericardial sac (arrows).

most serious of potential complications of selective angiocardiography.

DISCUSSION

A few comments are in order as to methods of preventing the various complications discussed in this paper. First, however, it is of interest to note that intracardiac injections of 70 per cent Urokon *per se* apparently cause no serious clinical symptoms. In a number of our patients with extravasation transitory cardiac arrhythmias developed, but the incidence was no greater than when no extravasation was observed. It is important, however, to avoid selective intracardiac angiocardiography in patients with unusual irritability of the myocardium. Paroxysmal tachycardia, for example, is considered an absolute contraindication. The heart should be continuously monitored by electrocardiography, as such constant observation may well permit the operator to abort serious or even fatal complications. The catheter should be moistened to avoid local irritation and thrombosis and should be gently manipulated to minimize endocardial trauma.

Catheter position is of great importance and should be determined immediately prior to injection. The significance of this final step is well demonstrated by Case II, in which extensive pulmonary infarction resulted because of faulty positioning of the catheter. Scout films in two planes at right angles to each other are essential for accurate localization. Placement of the catheter in the coronary sinus or cardiac veins, with injection of contrast material, is dangerous, and a number of complications (6, 8) have been reported as a result of such catheter positioning. Perforation of the myocardium with bleeding into the pericardium and cardiac tamponade is always a serious potential hazard. The injection of contrast material through the myocardium into the pericardial sac has been reported (3) elsewhere than in this paper. Complications of this nature can be prevented by careful manipulation and precise localization of the catheter tip at all times.

Adequate oxygenation is of extreme importance, especially in cyanotic patients. Dickerson (2) found that administration of oxygen before, during, and after injection

of contrast material in cyanotic patients appreciably reduced T-wave inversion. The occurrence of ventricular fibrillation in a poorly oxygenated patient in our study led to routine hyperventilation of all patients with oxygen while under intravenous anesthesia and prior to injection of the contrast medium. Although it is known that intravenous anesthesia involves a minimal risk, this risk is more than offset by patient control and better oxygenation. The administration of 100 per cent oxygen also permits the maintenance of patients in an apneic state during filming. Thus better films are obtained due to lack of motion.

The prevention of mechanical complications has been discussed previously in this paper and will not be expanded upon at this time. There are certain contraindications to selective angiocardiography, however, which should be mentioned. These include recent coronary occlusions (six weeks or less), subacute bacterial endocarditis, and digitalis toxicity. The use of concentrated contrast material such as 70 per cent Urokon or Cardiografin is considered hazardous in patients with severe nephritis or liver damage.

Other prophylactic measures to be considered include utilization of sterile technics, administration of antibiotics before and after selective studies, and the avoidance of air embolism by suitable catheterization technic. A thoracotomy tray, cardiac defibrillator, suitable drugs, and equipment for maintenance of adequate ventilation of the patient should be immediately available at all times.

SUMMARY

1. The complications of selective angiocardiography have been briefly discussed, with comments based primarily upon the experience gained from a series of 250 such examinations.

2. Illustrative cases have been presented to portray the "radiographic" complications observed in this study.

3. A few comments are offered as to methods of preventing complications which might be normally anticipated in selective angiocardiography.

4. In most instances it appears that the extravasation of 70 per cent Urokon into the myocardium produces no significant clinical reaction.

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SUMMARIO IN INTERLINGUA

Complicationes de Angiocardiographia Selective

Le autores revista lor experientia con complicationes resultante del effectuation de 250 studios de angiocardiographia selective. Iste complicationes esseva dividite in tres categorias general: mechanic, clinic, e radiologic, con un certe grado de coincidentia transitional.

Le complicationes mechanic include le

difficultates technic causate per un malfunction del apparato pro le excambio de pelliculas, per un panna del apparato de injection, per excessos del carga del tubos de radios X, per le resalto del catheter, e per defectos physic in le catheteres.

Le complicationes clinic includeva 5 reactiones allergic; 2 (cata un) de infarcimento pulmonar, de reaction inflammatori, de hypotension, e de spasmo arterial; 1 caso (cata un) de tamponage cardiac, de arresto respiratori, de fibrillation ventricular, de grand mal, e de hemiplegia. Occurreva 1 morte.

Le complication radiologic le plus commun esseva extravasation de substantia de contrasto a in le myocardio. Isto esseva vidite in approximativemente 8 pro cento de omne le casos de injection intracardial, sed in le majoritate del casos iste occurrentia non esseva sequite per un significative reaction clinic.

Mesuras pro le prevention de complicationes include le meticulose selection del patientes, con attention prestate a certe contraindicationes contra le methodo, le continue observation del corde per medio de electrocardiographia, humectation del catheter e delicatessa in su manipulation, le precise location del puncta del catheter ante le injection del substantia de contrasto, e un adequate oxygenation. Complicationes mechanic pote esser evitate per prestar attention al detalios technic e al apparatura.

Casos illustrative es includite.

Surgically Correctable Renal Hypertension

A Review and Presentation of Four Cases[1]

JOSEPH J. BOOKSTEIN, M.D., and HERBERT L. ABRAMS, M.D.

As early as Bright's original publication in 1836 (4), the relationship between renal disease and hypertension was suspected, but it was not until Goldblatt's report in 1933 (15) that widespread interest developed in the study of this relationship, and in the etiologic role of unilateral renal disease in human hypertension. Since that time it has been repeatedly demonstrated (16, 22) that in dogs and other animals the application of a clamp to one renal artery so as to interfere with the blood supply will consistently produce moderate, but temporary, hypertension. Contralateral nephrectomy or clamping of the contralateral renal artery results in permanent hypertension. Upon removal of the clamps or excision of a unilaterally clamped kidney, the pressure quickly reverts to normal.

Experimental evidence indicates that the acutely ischemic kidney produces a substance called renin, which, though not itself a vasoconstrictor, reacts with another substance known as hypertensinogen (present in normal serum) to form hypertensin, a potent pressor agent (16). Increased amounts of renin have been indirectly demonstrated in the perfusate of acutely ischemic animal kidneys and sporadically in human kidneys (16, 40), but never in the kidneys or sera of animals with *chronic* renal hypertension (38). High serum levels of hypertensin have been found in patients with chronic benign and malignant hypertension (32). Although the renin-hypertensin system may be responsible for the hypertension immediately following acute renal ischemia, it is probable that other, as yet poorly defined, mechanisms are responsible for chronic hypertension of renal origin (22).

It has been estimated that 0.5 to 2.0 per cent of all hypertensive patients have surgically correctable renal lesions (34). Examples may be found in all age groups, from infancy and childhood through old age (2, 6). Because of the increasing interest in these lesions, we are reporting 4 cases which illustrate pertinent diagnostic features.

CASE REPORTS

Case I: *Hypertension Associated with Renal Arterial Stenosis and Aneurysm* (courtesy of Drs. William Anderson and William Powers). I. B., a 25-year-old white female, was known to have had hypertension since the age of thirteen. This had gradually progressed, despite medical therapy. Physical examination revealed a blood pressure of 180/110. There was mild hypertensive retinopathy. The heart was not enlarged. Differential function studies demonstrated that the right kidney excreted 435 c.c. in one hour, while the left excreted 76 c.c. Urea clearance on the right was 50 per cent, on the left 40 per cent. An intravenous pyelogram showed that the left kidney was slightly smaller than the right and concentrated the opaque medium more satisfactorily. (Fig. 1, A). Aortography demonstrated narrowing of the left main renal artery just proximal to a small aneurysm (Fig. 1, B). Nephrectomy was performed, followed by a return to normotensive levels, which has been sustained since surgery (patient well over a year). Study of the excised left kidney revealed an abrupt stenosis of the main artery caused by medial muscular thickening. There was also a small aneurysm of the arterial branch to the lower pole. No significant renal parenchymal abnormalities were present and the kidney was within normal limits of size.

Case II: *Hypertension Associated with Stenosis of the Renal Artery.* J. M., a 31-year-old female, had hypertension beginning two years prior to hospital admission. On physical examination the blood pressure was 210/136, and there were grade 3 retinopathy and mild cardiac enlargement. Differential function studies demonstrated a urine flow of 90 c.c. in one hour on the left, and 20 c.c. on the right. The creatinine concentration was 25 mg. per cent on the left and 50 mg. per cent on the right. Urography showed that the right kidney measured 3 cm. less than the left, but there was equivalent

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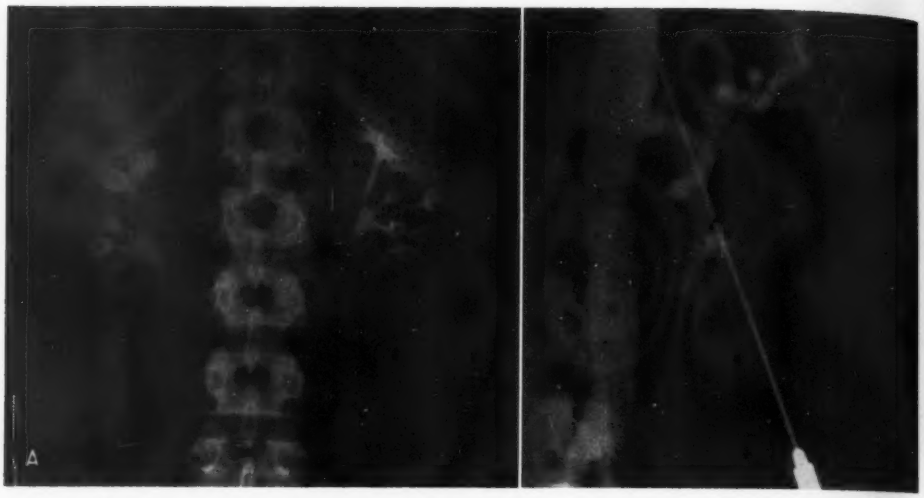

Fig. 1. Case I. A. Intravenous pyelogram. The left kidney is significantly smaller than the right. The concentration on the left is greater than on the right, presumably due to augmented tubular reabsorption of water. B. Translumbar aortogram in left posterior oblique projection. There is abrupt narrowing of the left renal artery (arrow), associated with an aneurysm (crossed arrow).

concentration of the contrast agent (Fig. 2, A). Comparison with a urogram obtained nine months earlier indicated that the right kidney had decreased almost 1 cm. in length, while the left showed no appreciable change. Aortography revealed stenosis of the right renal artery just distal to an apparently normal branch to the upper pole (Fig. 2, B). There was a decreased nephrogram effect in the lower half of the kidney (Fig. 2, C). Following right nephrectomy, the blood pressure dropped abruptly, and has remained at about 145/100 for over a year since surgery. The excised kidney weighed 90 grams. There was a coarctation of the artery to the lower two-thirds of the kidney, resulting from subintimal and medial fibrous hypertrophy. The cortex and medulla of the lower two-thirds of the kidney were markedly atrophic.

CASE III: *Hypertension Associated with Thrombosis of the Renal Artery and a Renal Infarct* (courtesy of Dr. Max Rukes). R. H., a 37-year-old white male, was normotensive and in good health until the sudden onset, one week before admission, of severe right upper quadrant pain, chills, and fever. At this time, a markedly elevated blood pressure was noted. Despite prompt remission of most symptoms, the blood pressure persisted at levels of about 230/130. An Amytal sedation test produced a drop in pressure from 200/120 to 130/102. Urography demonstrated a very small, poorly functioning right kidney. A right nephrectomy was performed, and at surgery it was noted that pulsations were absent in the right renal artery. During the next few days the blood pressure decreased to 120/80 and has remained there for well over two years. The kidney specimen weighed 118 grams. At the hilus an organized thrombus or embolus partially occluded the renal artery. A recent infarct was present near the upper pole. Aside from a few areas of mild chronic focal pyelonephritis, the remaining parenchyma appeared normal.

CASE IV: *Hypertension Associated with Thrombosis of a Renal Arterial Aneurysm.* P. P., a 28-year-old white female, was found to have a blood pressure of 180/110 during a routine physical examination. Three months earlier her blood pressure had been 120/80. Headache, malaise, and weakness developed and progressed rapidly. Within a month the pressure had risen to 180/120, and hypertensive retinopathy appeared. On the preliminary film of the abdomen, a faint curvilinear calcific density, thought to represent an aneurysm, was noted in the region of the left renal artery. Intravenous pyelograms showed a small left kidney with virtually no function. On retrograde pyelography, the calyces and pelves appeared normal on both sides. A left nephrectomy was performed, revealing a fusiform aneurysm at the base of the left renal artery, with absence of pulsations distal to it. By the end of the procedure the blood pressure was normal. It has remained at a level of 100/70 for a period of eighteen months.

The kidney weighed 75 grams. There was marked diffuse cortical and tubular atrophy. The aneurysm was not excised, but in the most proximal segment of renal artery included with the specimen, a small amount of antemortem thrombus was found. This was thought to represent a portion of a larger thrombus attached to the intima of the aneurysm.

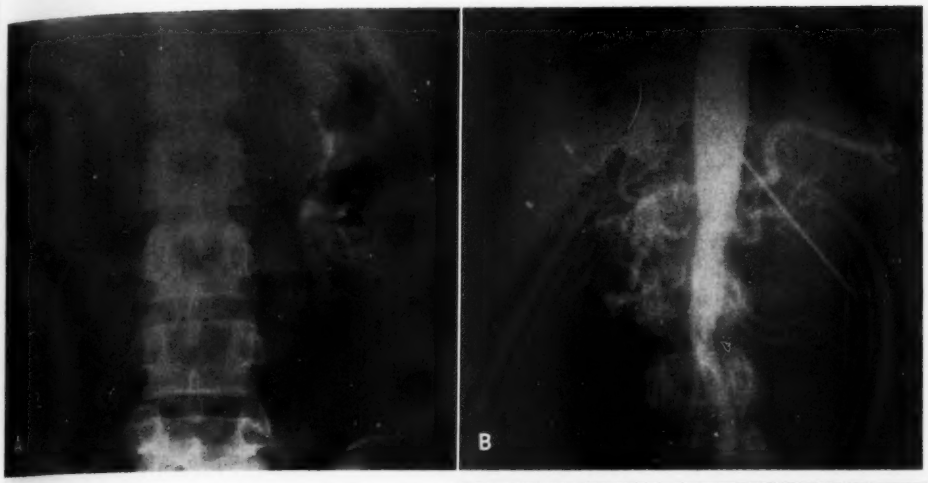

Fig. 2. Case II. A. Intravenous pyelogram. The right kidney is somewhat smaller than the left, but there is equal concentration of the medium bilaterally.

B. Translumbar aortogram, arterial phase. Note the abrupt stenosis of the right renal artery (arrow) beyond the origin of a branch to the upper pole. The right renal artery is narrower than the left, reflecting the diminished blood flow (11).

C. Translumbar aortogram, nephrogram phase. The nephrogram effect is markedly diminished in the lower two-thirds of the right kidney. The difference in renal size is clearly visible.

ETIOLOGY OF RENAL HYPETENSION IN MAN

The etiologic factors in renal hypertension may be divided into two broad categories, vascular and parenchymal.

A. Vascular Factors: Virtually any lesion which compromises the renal arterial supply on one or both sides may produce hypertension (Table I). This represents

TABLE I: VASCULAR LESIONS ASSOCIATED WITH HYPERTENSION OF RENAL ORIGIN (AFTER DECAMP AND BIRCHALL)

A. Congenital
   1. Stenosis of the renal artery.
   2. Abdominal aortic coarctation, with or without associated renal arterial stenosis.
   3. Renal artery aneurysm.
   4. Multiple renal arteries with stenoses or occlusions of one or more.

B. Acquired
   1. Atherosclerosis
      (*a*) Of renal artery
      (*b*) Of aorta near renal artery
      (*c*) With ascending thrombotic occlusion of the aorta.
      (*d*) With abdominal aortic or renal arterial aneurysm.
   2. Thrombosis or embolism of the renal artery, with or without infarction.
   3. Necrotizing vasculitis of the renal arteries.
   4. Syphilitic arteritis.
   5. Trauma with thrombosis, hematoma, arteriovenous fistula or foreign body occlusion.
   6. Tumor, extrinsic or intrinsic.
   7. Fibrous bands.

the human counterpart of a Goldblatt kidney. In children and young adults, coarctation of the renal arteries, usually secondary to fibrous intimal thickening, is the most common obstructing lesion (6, 9, 27). In adults, arteriosclerotic plaques are usually found. Thus, in 26 of 30 adult cases reported by Poutasse (28), there was atheromatous narrowing.

Nevertheless, it must be emphasized that hypertension in young adults may be

associated with narrowing of the renal artery unaccompanied by significant atheromatous change. Thus, in Case I, stenosis of the left renal artery in a 25-year-old woman was caused by medial muscular hypertrophy of a marked degree. In Case II, narrowing of the right renal artery resulted from significant medial and subintimal fibrous hypertrophy. In both cases evidence of arteriosclerosis as the cause of narrowing was lacking.

The character of the localized change in the renal artery seen in young adult patients and children is a matter which remains to be explained. Its occurrence in younger patients, including infants (9), and its frequent association with coarctation of the aorta (5, 9) support a congenital origin. It has none of the characteristics of acquired atheromatous occlusion. There is no evidence of an underlying inflammatory vasculitis. This is, then, a lesion which deserves intensive study if its nature is to be clarified.

Following renal infarction, hypertension may develop in as many as a third of the cases, although it is usually transient (1, 20). Howard (20) has observed that the necrotic zone is usually sharply demarcated from normal adjacent parenchyma in renal infarction. In 2 of his cases associated with hypertension, the necrotic area was surrounded by a zone of atrophic renal tubules, "clear evidence of reduced arterial supply to still viable renal tissue".

There is some evidence for a contributory renal humoral mechanism in the hypertension associated with coarctation of the aorta. Thus, experimental partial obstruction of the aorta above the renal arteries produces hypertension in both the upper and lower extremities; obstruction below the renal arteries usually fails to produce any hypertension (16, 31).

B. Parenchymal Factors: That there is some relationship between hypertension and renal parenchymal disease is indicated by available evidence (5, 39), but the precise nature of that relationship has not been clarified. Approximately 40 per cent of patients with a "chronic atrophic kidney" have associated hypertension (13, 33); cure rates following nephrectomy in these patients range from 55 to 67 per cent (13, 35). The "chronic atrophic kidney" represents a spectrum of lesions: congenital hypoplasia and aplasia, chronic atrophic pyelonephritis, chronic obstructive uropathy, vascular occlusion, infarcts, and calculus may all terminally lead to this appearance (13). This heterogeneous group may justifiably be treated as one entity, since fine differences in details of the pathologic picture, such as the presence of infection or arteriolosclerosis, do not correlate with results after nephrectomy (13, 19).

Other parenchymal disorders, such as hydronephrosis, pyonephrosis, tuberculosis, and renal tumors, are less commonly associated with hypertension and show correspondingly less favorable results following nephrectomy (35).

In seeking a common factor in cured cases, interest has recently begun to focus on the role of partial obstruction of the larger renal arteries. The status of these arteries was rarely mentioned in early clinical reports, perhaps because renal arteriography was performed uncommonly and nephrectomy specimens omitted significant portions of the renal arteries. Recently, however, there has been emphasis on the better prognosis in patients having known obstructive vascular lesions, with or without associated parenchymal disease (2, 6, 7, 19). Furthermore, no instance has been found in the literature of a cure of hypertension by nephrectomy in which definite absence of arterial obstruction was demonstrated by arteriography or surgery.

DIAGNOSIS

The most effective diagnostic agents are renal arteriography and differential renal function studies. Certain features of the conventional investigation of hypertensive patients may suggest the diagnosis and make possible selection of patients suitable for further studies.

A. Clinical Findings: Hypertension beginning under the age of twenty or over

the age of fifty, absence of a family history of hypertension, and a rapidly progressive course with early retinopathy may suggest a renal origin (26), but there are many exceptions. A history of flank pain may be an indication of renal infarction as in Case III (19). Routine laboratory findings are usually normal, but the absence of urinary protein in the presence of malignant hypertension is suggestive of bilateral renal arterial stenoses (27). The therapeutic response to antihypertensive drugs is not helpful in diagnosis (19).

B. Intravenous Pyelography: Although the intravenous pyelogram is frequently normal in unilateral renal hypertension, in about half the cases some abnormality will be visible (28). Since the majority of reported cures have followed the excision of small kidneys, renal size must be carefully studied. Comparison with the opposite side is the best method of evaluation. Although the right kidney is, on the average, slightly smaller than the left (25), Hodson has reported that measurements of the long axes of the kidneys on both sides are usually quite similar (18). Apparent dissimilarity in normal subjects is most commonly associated with a bifid kidney; occasionally, a short fat kidney will have a long thin contralateral mate. In the absence of these obvious exceptions, the long axes of the two kidneys should not normally differ by more than 1 cm. A difference of 1.5 cm. suggests unilateral atrophy, particularly if the thickness of the parenchyma is also decreased (18). Progressive diminution in the size of a kidney over a period of months is a significant observation, since it may reflect the atrophy that is known to occur following partial vascular occlusion (19, 40). We have personally observed progressive atrophy over a nine-month period (Case II). In Case IV, marked atrophy was present after a documented history of hypertension of no more than five months duration.

Urography provides a rough index of the status of renal function. In the volume customarily employed, most of the opaque medium is excreted by the glomeruli (20). The medium in the glomerular filtrate is concentrated 100 to 200 times by the tubular reabsorption of water and additional tubular excretion of medium (21). Thus, the tubules are mainly responsible for the density of the collecting system, and apparently it is the tubular concentrating power which is best judged by the intravenous pyelogram (12). This may bear an inconstant relationship to the total excretory capacity of a kidney, as indicated by the occasional discrepancies between the pyelogram and clearance tests. In general, unilateral decreased density correlates well with diminished function by clearance tests; on the other hand, normal density is not uncommonly seen despite mild to moderate functional impairment as demonstrated by other tests (10, 17). It is apparent from the 4 cases presented that the function of the involved kidney is variable in renal hypertension, with corresponding variations in the urographic appearance. With minimal degrees of vascular stenosis, tubular concentrating power is often disproportionately well preserved (2, 30). Thus, the density frequently appears normal despite diminished clearances and may even be better than on the uninvolved side (Fig. 1). With gross disease, there may be no visualization at all.

C. Retrograde Pyelography: Retrograde study is most useful when there is nonvisualization by intravenous urography. A relatively normal retrograde pyelogram associated with failure of visualization by intravenous urography is strongly suggestive of obstruction of the renal artery (Case 4). When adequate concentration is obtained on the intravenous study, the retrograde pyelogram serves no significant purpose.

D. Differential Function Tests: No case of renal hypertension in human subjects is known in which all differential studies were normal (33), and these tests are a useful guide in the diagnosis. In most cases there will be multiple functional abnormalities, including decreased glo-

merular filtration rate and decreased effective renal blood flow. These findings are not specific, however, and may be present in renal parenchymal disease that is not etiologically related to hypertension (2, 17, 24). The significant derangements are unilaterally diminished urine flow in associated with increased urine osmolarity (2, 30). Indeed, in cases of minimal arterial stenosis, these may be the only striking abnormalities (2), and the presence of a number of virtually normal function studies may be deceptive. The urine flow on the involved side is usually markedly diminished, often amounting to only 20 per cent of the contralateral flow. This is largely the result of excessive tubular reabsorption of water, despite the water-loading incident to function studies. In addition, hypertension tends to cause decreased reabsorption of water by the contralateral kidney, thereby augmenting the difference in flows on the two sides. In the presence of a glomerular filtration rate which is but slightly diminished, the increased tubular reabsorption of water produces a higher urine concentration of inulin or creatinine on the involved side. Thus, the combination of diminished urine output and increased inulin or creatinine concentration on one side is strongly suggestive of unilateral renal arterial obstruction (2, 30) (Cases I and II).

E. Renal Arteriography: Arteriography may constitute a definitive diagnostic method. Its ability to demonstrate bilateral arterial lesions is a distinct advantage. Although the catheter approach is preferable, translumbar aortography is usually adequate. Arteriographic investigation is indicated (2, 28) in patients:

1. With hypertension beginning under the age of twenty and over the age of fifty, particularly if a family history of hypertension is absent.
2. With sudden onset of severe hypertension.
3. With sudden increase in the severity of hypertension.
4. With hypertension following an attack of flank pain.
5. With unexplained differences in size or function of the two kidneys as shown by urography.

Using these indications, Poutasse performed 104 arteriographic studies in three years and demonstrated focal renal arterial disease in 30 patients (28).

With good opacification of the renal arteries, areas of constriction, dilatation, or nonvisualization may be noted (Figs. 1, B and 2, B). At times, minimal stenosis of questionable significance may be demonstrated. This may require further evaluation at the time of surgery by pressure determinations proximal and distal to the stenosis (2). A number of confirmatory signs of vascular impairment should be sought. The presence of post-stenotic dilatation implies a significant degree of obstruction (9). If the arcuate arteries are visualized, the cortical width can be estimated. Disparity between the two sides may be evidence of ischemic cortical atrophy. The nephrogram should be observed. A wedge-shaped zone of non-opacification may be noted with renal infarcts. Alteration of the nephrogram effect to a portion of the kidney in one of our cases (Fig. 2, C) helped confirm the significance of a visualized stenosis.

THERAPY AND RESULTS

Nephrectomy is the treatment of choice in cases with severely damaged kidneys (28). In the presence of bilateral arterial disease or relatively normal renal function on the involved side, arterial surgery, including endarterectomy, graft or resection, and anastomosis (14) may be preferable. In general, the earlier surgery is instituted, the better the prognosis; exceptions to this rule are common, however, as exemplified by the dramatic response in Case I, despite hypertension of at least twelve years duration.

Excellent results are reported after arteriographic demonstration of vascular obstruction. Of such cases, 80 per cent

or more are cured or markedly improved (6, 9, 19, 28). Nephrectomies performed without benefit of arteriography yield less satisfactory results. Of a total of 575 patients undergoing nephrectomy for hypertension prior to 1956, 25 per cent were cured and an additional 25 per cent were significantly improved (34). It is not clear, however, in precisely what proportion of these cases renal arterial obstruction was present.

SUMMARY

Renal disease should always be considered as a possible cause of hypertension. Although there is some association between renal parenchymal disease and hypertension, most recent surgical cures have been reported in cases with obstructive renal arterial lesions. Arteriography is the most reliable diagnostic method, but many features of the routine hypertensive work-up can serve effectively to screen suitable candidates. Clinically, the disease in these patients frequently pursues a rapidly progressive course. The intravenous pyelogram will be abnormal in about half the cases. Slight disparity between renal sizes should direct suspicion toward the smaller kidney. Progressive decrease in the size of one kidney may be highly significant. Renal function, as judged by urography, may be absent or even apparently better than normal. Appropriate differential renal function tests are almost always abnormal. In the presence of a proved arterial obstruction, cure or marked improvement will follow nephrectomy or vascular surgery in most cases.

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SUMMARIO IN INTERLINGUA

Hypertension Renal, Corrigibile per Medios Chirurgic: Un Revista e Un Presentation de Quatro Casos

Morbo renal deberea semper esser considerate como un causa possibile de hypertension. Ben que il existe un certe association inter morbo parenchymal renal e hypertension, le majoritate del recente curationes chirurgic esseva reportate in casos con lesiones obstructive del arterias renal.

Arteriographia es le plus solide methodo diagnostic e es indicate in patientes con (1) hypertension comenciante infra le etate de vinti e supra le etate de cinquanta annos, specialmente in le absentia de un historia familial de hypertension, (2) un subite declaration de sever hypertension, (3) un subite augmento in le severitate del hypertension, (4) hypertension post un attacco de dolores in le flanco, e (5) inexplicabile differentias in le dimensiones o le function del duo renes secundo le resultatos de un studio urographic.

Multe aspectos del studios routinari de patientes hypertensive es etiam utile in le selection de candidatos pro le intervention chirurgic. Le curso clinic del morbo es frequentemente rapide e progressive. Le pyelogramma intravenose es anormal in circa un medietate del casos. Un leve discrepantia inter le dimensiones del duo renes debe diriger le suspicion del medico verso le ren plus micre. Un reduction progressive in le dimensiones de un del renes es possibilemente multo significative. Le function renal, judicate per urographia, pote esser absente sed etiam apparentemente melior que normal. Tests del function renal differential es semper anormal.

In le presentia de un provate obstruction arterial, curation o marcate grados de melioration seque le nephrectomia o le chirurgia vascular in le majoritate del casos.

Es reportate quatro casos que illustra hypertension associate con (1) stenosis e aneurysma del arteria renal, (2) stenosis del arteria renal, (3) thrombose del arteria renal e un infarcto renal, e (4) thrombose de un aneurysma del arteria renal.

Neurilemmoma of Bone

Report of 3 Cases with a Review of the Literature[1]

THOMAS G. SAMTER, M.D.,[2] FRANK VELLIOS, M.D., and WILLIAM G. SHAFER, D.D.S.

NEURILEMMOMA IS a benign encapsulated tumor arising from the sheath of Schwann, occurring along the course of the peripheral, cranial, and sympathetic nerves. It was first described histologically by Verocay in 1908 and called neurinoma. Subsequently, a number of names have been attached to it, among which are perineural fibroblastoma, schwannoma, and peripheral glioma. In 1935 Stout reviewed the subject exhaustively and presented 52 cases of his own. He coined the term "neurilemoma," thereby emphasizing the origin of the tumor from the nerve sheath (16).

The neurilemmoma is a benign neoplasm which is characteristically encapsulated and usually solitary, although occasionally a patient may have several such tumors. It may occur in persons with von Recklinghausen's disease, but often no stigmata of that condition are present. Usually, the tumors are solid grossly, but the larger ones, especially those in the posterior mediastinum, may contain large cysts.

Histologically, two types of cell arrangement are seen. These types were first illustrated by Verocay but, according to Stout, were more sharply defined by Antoni as types A and B tissue. Type A tissue is composed of closely packed, spindle-shaped cells arranged in twisting bands or cords. The nuclei of these cells are often aligned in rows, so-called palisading, with intervening spaces without nuclei. When this arrangement is such as to assume an organoid appearance, the structures are known as Verocay bodies. The type B tissue is also composed of Schwann-sheath cells, but the cells are arranged in a loose, haphazard fashion. Microcysts may be present in such regions and histiocytes, sometimes laden with lipid, are often found. Nerve fibers may be present in the peripheral portion of the tumor and are often found in the capsule, but these are not an integral part of the neoplasm. In this respect neurilemmoma differs from neurofibroma and traumatic neuroma (17). The neurofibroma is characterized by diffuse, haphazard proliferation of peripheral nerve elements, including schwannian cells and neurites. It does not form the twisted Verocay bodies but may produce caricatures of Wagner-Meissner tactile corpuscles. The traumatic neuroma is also composed of neurites and schwannian cells, but these have an orderly arrangement rather than the haphazard proliferation of the neurofibroma.

Neurilemmomas in other tissues are not rare, but they have been reported only infrequently in bone. None of Stout's 52 cases was intraosseous. This is probably owing to the scarcity of nerves in bone tissue, the mandible excepted. We have been able to find descriptions of only 12 cases of neurilemmoma of bone in the literature and are presenting 3 additional examples which we have had an opportunity to study.

CASE REPORTS

CASE I: An 18-year-old white man was seen in February 1956. Six weeks before admission, in the course of lifting, he had "sprained his back." Roentgenograms taken at that time were interpreted as showing a "cystic" area in the sacrum and the patient was referred to the Indiana University Medical Center. He stated that the discomfort in his back was of short duration only, and on entering the hospital he was asymptomatic.

The patient had previously been admitted to this institution at the age of twelve years. As a result of a blow to his left leg, he had sustained a fracture of the tibia through a unicameral bone cyst. The cyst was curetted and postoperatively exhibited

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Fig. 1. Case I. Ovoid area of radiolucency in right sacral wing. There is also spina bifida occulta involving the sacrum.

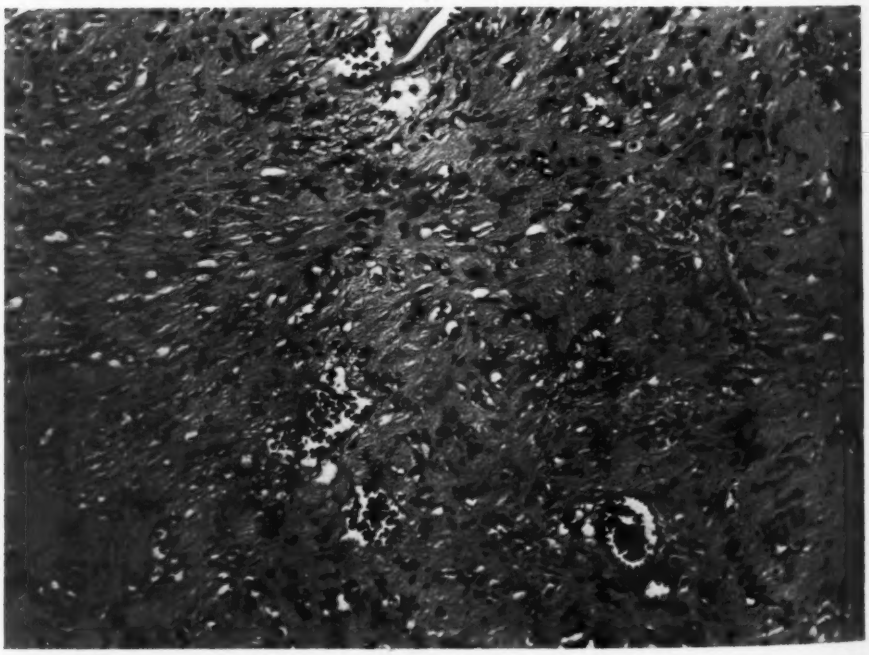

Fig. 2 Case I. Photomicrograph of the excised tissue, illustrating Antoni type A tissue. Hematoxylin and eosin. × 150.

slow but progressive decrease in size. The fracture healed uneventfully. The past history, review of systems, and family history were not otherwise remarkable.

The patient was well developed and in no distress. No abnormalities were noted and no tenderness or masses were observed in the back. In the roentgenogram, an area of radiolucency was seen in the right sacroiliac region (Fig. 1). There were, in addition, a spina bifida occulta involving the first sacral vertebra and a hiatus below the vertebra. On a routine bone survey, the cyst in the right tibia was found to be still present; no other lesions were seen. Routine hemogram and urinalysis were within normal limits. On Feb. 7, the patient was taken to surgery. The right wing of the sacrum was exposed and the cavity of the cyst was entered. About 150 ml. of tumor tissue was removed. The cavity was lined by fairly smooth bone with multiple longitudinal ridges. Bleeding during removal of the tumor was brisk, and 1,200 ml. of blood was administered. The postoperative course was uneventful. The patient was last seen Sept. 12, 1957, at which time he was asymptomatic. The defect in the sacrum was smaller but still present.

The resected specimen consisted of two pieces of tissue, 4.5 × 3.5 × 1.5 cm. and 2 × 1.5 × 1 cm. The tissue was soft and reddish white, with areas of gelatinous consistency.

Histologically, the two characteristic types of tissue were seen (Fig. 2). The more solid regions (Antoni type A) of spindle-shaped cells arranged in twisted bands comprised most of the tumor. Typical palisading of nuclei was present in these areas. Arrangement of these cells in structures resembling Verocay bodies was apparent. The regions of loosely arranged spindle-shaped cells (Antoni type B tissue) were small, and no cystic formations were seen.

CASE II: A 20-year-old married Negro woman was first seen at Indiana University Medical Center Nov. 21, 1954, because of swelling of the left side of the jaw of one year duration. Following the extraction of the left mandibular third molar, she had gradual onset of pain and swelling in that region. In addition, she stated that for nine years she had had two small nodules within the left nostril. Past history, review of symptoms, and family history were noncontributory. Physical examination revealed a hard, moderately tender mass involving the mandible near the ramus. It extended both medially and laterally. There were two firm nodules, 1.5 cm. and 0.3 cm. in diameter, in the nose. One was on the medial wall of the left nostril and the other on the anterior part of the nasal septum. The remainder of the physical findings were within normal limits. On laboratory examination, no urinary abnormalities were detected. The hemoglobin was 8.8 gm. per 100 ml. and the red blood corpuscle count 3.17 million. The total leukocyte count was 6,400, with 53 per cent neutrophils, 27 per cent eosinophils, 15 per cent lymphocytes, and 6 per cent monocytes. The platelet count was 662,530. The sternal bone marrow was hyperplastic; otherwise no diagnostic features were found.

Fig. 3. Case II. Destruction of the ramus, angle, and posterior portion of the body of the left mandible. Above, postero-anterior view, showing the lesion on the left; below, lateral jaw view.

On the roentgenograms a large region of destruction involving the ramus, the angle, and the posterior portion of the body of the left mandible was noted, with partial resorption of the roots of the second molar (Fig. 3). The cortex was expanded and thin. Roentgenograms of the chest and lower gastrointestinal tract were within normal limits. No explanation for the patient's anemia was found, and she received blood transfusions. The lesion of the mandible was biopsied and on Nov. 23, the tumor of the nasal septum was excised.

On Dec. 4, 1954, the left mandible was explored through a cutaneous incision. The bone was eroded over a 0.7-cm. area at the angle, in the region of the biopsy. The cortex was very thin and easily removed; medially, it was completely resorbed. The tumor was gray-white and resilient and appeared encapsulated except in the region of the biopsy site. The left mandibular nerve seemed to be involved by the mass. Ninety grams of tissue were removed and a 4 × 5-cm. cavity was left in the mandible. The tumor was incompletely removed at this time in order not to fracture the mandible.

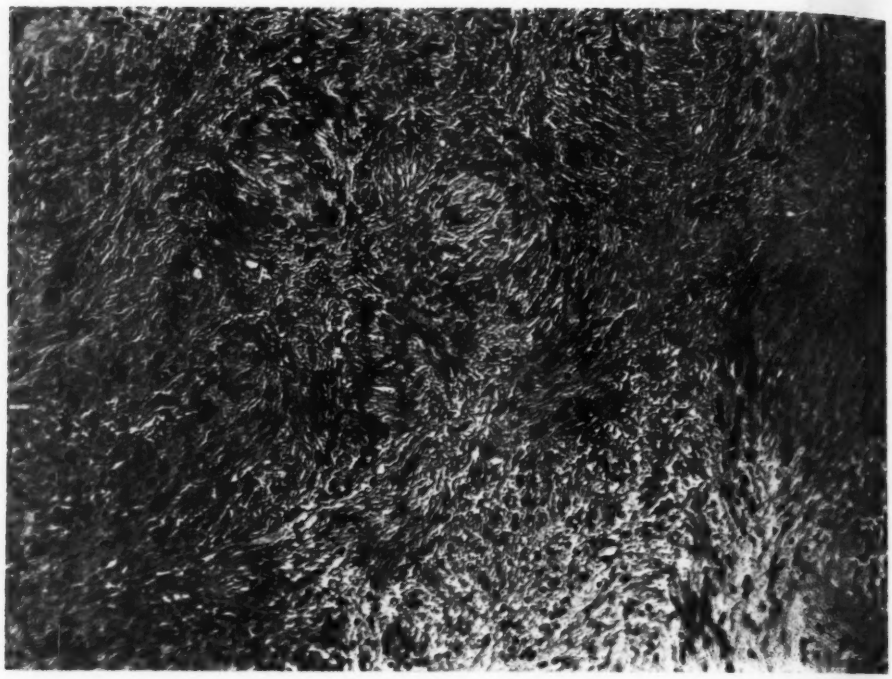

Fig. 4. Case II. Photomicrograph of the tumor: Antoni types A and B tissue. Verocay bodies are numerous. Hematoxylin and eosin. ×200.

Postoperatively, there were drainage and some pain at the operative site.

The patient was readmitted and on June 4, 1955, 3 gm. of tissue were removed. On Feb. 12, 1957, she was again operated upon, with the removal of a few more fragments of tumor tissue. In addition, the nodule was removed from the left nostril. Pain and swelling in the region of the angle of the mandible continued, however, and in view of this, on June 3, by an intraoral approach, the inferior alveolar nerve was transected and the mandible was explored. A 3-cm. defect containing tumor tissue was found. Approximately 4 gm. of tissue were removed. The postoperative course was favorable for about a month. Subsequently cellulitis of the left side of the jaw developed. A persistent mass was noted at the angle but remained relatively constant in size. The patient was still complaining of pain in the region of the left mandible when last seen, Aug. 9, 1959.

The histologic appearance of the lesions in the nose and the mandible were similar (Fig. 4). The predominant pattern was the Antoni type A. Verocay bodies were numerous. Antoni type B tissue was present in small amounts.

CASE III: A 34-year-old white man experienced pain and tenderness in the right arm following trauma by a baseball. A defect in the cortex at the level of the nutrient foramen was demonstrable on the roentgenogram (Fig. 5). At operation, an encapsulated, dumbbell-shaped nodule was removed from this region, just lateral to the insertion of the deltoid muscle. Grossly, the tissue was firm and gray. Microscopically, the lesion contained both Antoni types A and B tissue. Verocay bodies were not numerous (Fig. 6).

DISCUSSION

Fifteen cases of neurilemmoma of bone, 12 from the literature and 3 seen by the authors, are summarized in Table I. The tumors produced no typical symptoms or clinical findings. The ages of the patients ranged from seventeen to sixty-five years at the time of excision. The 17-year-old boy gave a history of onset of symptoms at the age of eleven. Of the 14 patients whose sex is known, 7 were males and 7 females. Apparently, any bone may be involved, but the lesion was most common in the mandible and sacrum, each being the site in 4 instances. The long bones of the extremities were involved in 5 cases, and the patella and a metacarpal

Fig. 5. Case III. Defect in the cortex of the humerus at the site of the neurilemmoma.

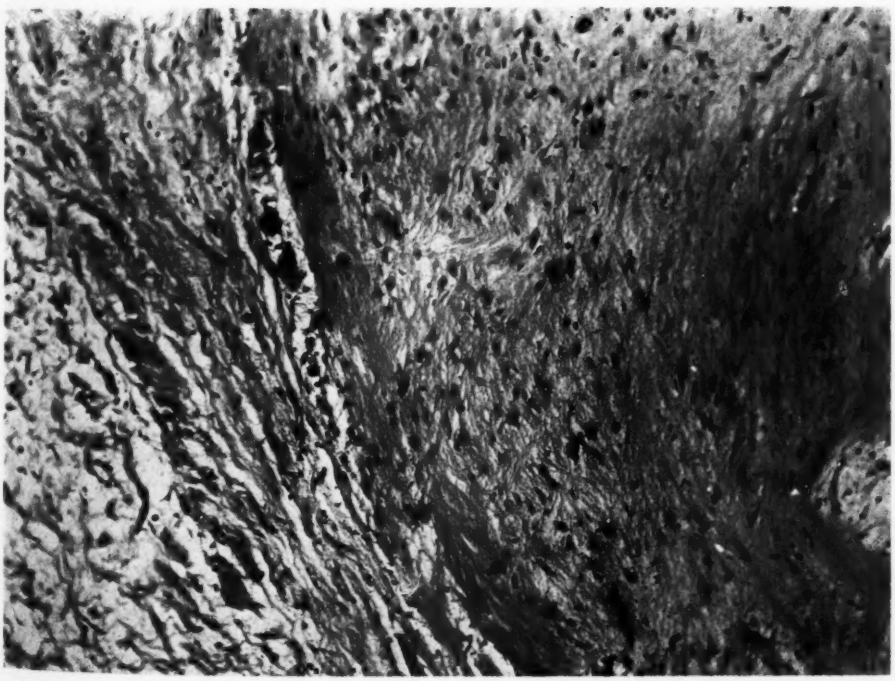

Fig. 6. Case III. Photomicrograph showing the Antoni A and B types of tissue. Hematoxylin and eosin. ×150.

TABLE I: SUMMARY OF CASES

	Author and Year	Age and Sex	Site	Remarks
1.	Peers (1934)	55 M	Right ulna	Aching and swelling of middle third of right forearm.
2.	Zilkens (1937)	17 M	Mandible	Swelling present since age eleven, increasing more rapidly one year.
3.	Gross, Bailey, and Jacox (1939)	30 F	Left humerus	Swelling and occasional dull ache, three years duration.
4.	De Santo and Burgess (1940)	37 M	Mid-shaft of right ulna	Pathologic fracture five times in eight years. Multiloculated, cystic, eroded lateral cortex.
5.	De Santo and Burgess (1940)	42 F	Right sacral wing	Pain. Tumor 4 × 6 cm. arising from dorsal root of 5th lumbar nerve and "invading" right sacral wing.
6.	Conley and Miller (1942)	32 F	First sacral vertebra	Pain along left sciatic nerve, numbness, coldness of entire left extremity, eleven years.
7.	Schroff (1945)	48 F	Ramus of left mandible	Swelling of buccal parietes for one month.
8.	Lichtenstein (1952; also cited by Jaffe, 1958)	.. ..	Patella	.....
9.	Jones (1953)	44 F	Left fourth metacarpal	Swelling on back of hand, two years.
10.	Dahlin (1957; also cited by Bruce, 1954)*	64 F	Mandible	.....
11.	Hart and Basom (1958)	46 M	Upper third right femur	Pathologic fracture when patient swung at baseball. Tumor dumbbell-shaped, at nutrient foramen.
12.	Jaffe (1958)	58 M	Sacrum	Pain in back, twenty years, persistent and radiating recently.
13.	Samter, Vellios, and Shafer (1960)	18 M	Sacrum	Pain in back, short duration.
14.	Samter, Vellios, and Shafer (1960)	20 F	Mandible	Gradual development of swelling following extraction of teeth, one year. Tumor re-excised 3 times because of size of original lesion.
15.	Samter, Vellios, and Shafer (1960)	34 M	Humerus	Pain and tenderness following trauma by baseball, short duration. Dumbbell-shaped tumor at nutrient canal.

* NOTE: This case was illustrated by a reproduction of the roentgenogram only, in Bruce's article, but not otherwise described. The case Bruce presented in detail was an extra-osseous neurilemmoma.

in 1 each. Involvement of the mandible might be expected more frequently because of the presence of the large mandibular nerve.

The presenting symptoms were swelling or swelling and pain in 6 patients, pain alone in 5, and pathologic fracture in 2. Symptoms were not recorded in 2 cases.

Neurilemmomas may involve bone in three ways. They may be central, producing rarefaction of the bone; they may be located in the nutrient canal, with production of a dumbbell-shaped tumor; they may be extraosseous, eroding the bone. The last type is often found in the posterior medastinum and along the course of the intercostal nerves. It is not considered here. The neurilemmoma was central in 12 of the 15 cases summarized. It was located in the nutrient canal and presented as a dumbbell-shaped tumor in Hart and Basom's case and in our third case. The tumor in De Santo and Burgess' second case was thought to arise from the fifth lumbar nerve, "invading" the right sacral wing.

These tumors rarely recur after excision, and to our knowledge no case of malignant change in a neurilemmoma has been observed. The case reported by Peers was thought to be sarcoma, but the illustrations in the article are consistent with benign neurilemmoma. Metastases were not noted clinically at the time the case was recorded. The persistence of tumor in the mandible in our second case was the result of incomplete removal at the first operation because of the size of the mass. Owing to the benign nature of the lesion,

local excision is the recommended therapy.

Tumors occurring in the mandible probably arise from the large mandibular nerve. It has not been possible to demonstrate a direct connection with a nerve in tumors in other bones, but it is presumed that they take their origin from the small nerves accompanying the nutrient vessels.

Neurofibromas producing lesions in bone as a part of von Recklinghausen's disease are not infrequent. Solitary neurofibromas of bone, however, are only rarely encountered. We were able to find 4 such instances recorded in the literature, all involving the mandible (5, 6, 10, 13). The case of Johnson and Wannamaker was associated with *café-au-lait* spots in the skin. Whether the other 3 were instances of neurofibromas or traumatic neuromas is difficult to determine from the illustrations.

SUMMARY

Three cases of neurilemmoma of bone are reported, and the findings in 12 other recorded instances are summarized.

Neurilemmoma of bone may arise centrally, or in the nutrient canal of bone. It may occur at any age, in either sex, and presumably in any bone. It has been found most frequently in the mandible and sacrum.

The presenting symptoms are usually swelling or pain, or both. Pathological fracture was the initial symptom in 2 cases.

Neurilemmoma is a benign tumor requiring only local removal.

ADDENDUM: After this manuscript was submitted, the patient in Case II continued to complain of severe pain. The ramus and a portion of the body of the mandible were resected on July 11, 1960. Persistent neoplasm was found throughout the specimen.

ACKNOWLEDGMENTS: We are grateful to Dr. K. R. Manning and Dr. Edwin E. Pontius of Methodist Hospital, Indianapolis, Ind., for kindly allowing us to use Case III.

The illustrations were prepared by Messrs. James F. Glore, Paris Johnson, and Joseph Demma of the Department of Illustration.

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(*Pro le summario in interlingua, vider le pagina sequente*)

SUMMARIO IN INTERLINGUA

Neurilemmona de Osso: Reporto de 3 Casos, con Un Revista del Litteratura

Neurilemmona es un incapsulate tumor que prende su origine in le vaina de Schwann al longo del curso de nervos peripheric, cranial, e sympathic. Reportos de illo in osso es infrequente. Le autores ha succedite a trovar 12 tal casos describite in le litteratura. Illes adde 3 ab lor proprie experientia, in un masculo de 18 annos de etate, in un femina de 20 annos de etate, e in un masculo de 34 annos de etate.

Neurilemmona de osso pote prender su origine centralmente o in le canal nutriente del osso. Illo pote occurrer a non importa qual etate, in ambe sexos, e—presumitemente—in non importa qual osso. Illo ha essite incontrate le plus frequentemente in le mandibula e in le sacro. Illo es un tumor benigne e require solmente le ablation local.

Le symptomas de presentation es usualmente tumescentia o dolores o ambes. Fractura pathologic esseva le symptoma initial in 2 casos.

Atlanto-Occipital Fusion, Basilar Impression, and Block Vertebrae Associated with Intraspinal Neurofibroma, Meningocele, and von Recklinghausen's Disease[1]

ARTHUR ZACKS, M.D.[2]

THE OBJECT of this paper is to present an unusual case in which a serious congenital skeletal deformity at the base of the skull was associated with an intraspinal cervical neurofibroma and meningocele at the same site, in a patient with von Recklinghausen's disease.

Error in embryological segmentation of the cervical spine is not characteristically associated with either intraspinal neurofibroma or meningocele, nor is intraspinal neurofibroma a common feature of von Recklinghausen's disease (neurofibromatosis of peripheral nerves remote from the central nervous system). von Recklinghausen's disease is, however, a congenital condition, often hereditary and sometimes familial. Penfield (10) made a distinction between multiple neurofibromatosis of von Recklinghausen and the solitary neurofibromas which occur on the nerve roots within the spinal canal and cranial vault. Grinker (3), on the other hand, points out that there is frequent association of acoustic neuromas, particularly, with peripheral neurofibromatosis. Among other less common sites of associated central nervous system neuromas he mentions the vagus, trigeminal, and hypoglossal cranial nerves. Furthermore, as Grinker mentions, gliomatous tumors of the spinal cord or brain, especially of the optic chiasm and tracts, may be associated with generalized neurofibromatosis.

If as a result of congenital bony dysplasia the bony arch surrounding the spinal canal remains partially open, the exposed meninges and cord become attached to superficial tissues and meningocele develops. This may occur at any level.

In the case presented below the roentgen features were typical of segmental deformity, *i.e.*, atlanto-occipital fusion with basilar impression and block vertebrae. Roentgenologic recognition and neurological examination were followed by surgical correction of the deformed bony arch, excision of an intraspinal neurofibroma, and drainage of the meningocele.

The principal roentgen features which may be observed in atlanto-occipital fusion are as follows:

1. Fusion of the atlas to the base of the skull. The neural arches and articular condyles are fused to the occipital bone although a vestigial or "remnant" joint may persist.
2. Distortion and constriction of the foramen magnum. Accessory eminences and ossicles may encroach upon and distort the foramen.
3. Lateral or forward dislocation of the atlas on the axis.
4. Nonsegmentation below the fused atlas. This is of common occurrence, and torticollis may be present if the block vertebrae are asymmetrical.
5. Basilar impression (elevation of the floor of the posterior fossa around the foramen magnum because of a funnel-shaped deformity.) This is frequently present.

The neuropathological features associated with the above abnormalities are:

1. Compression and destruction of the spinal cord secondary to bony impingement upon and constriction of the foramen magnum.
2. Impaired vascular supply to the spinal cord.

[1] Accepted for publication in December 1959.

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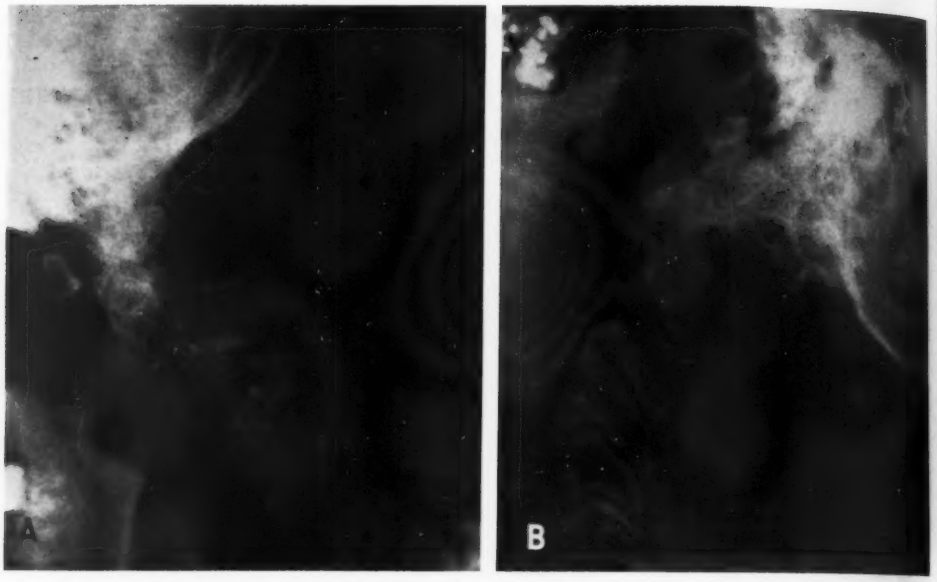


Fig. 1. Lateral projections of cervical spine during flexion (A) and extension (B), demonstrating unusually close proximity of the first cervical arch and the occipital bone, without separation of the arch from the occiput during flexion. This indicates atlanto-occipital fusion. Block vertebrae (C-2 and C-3) are also shown.

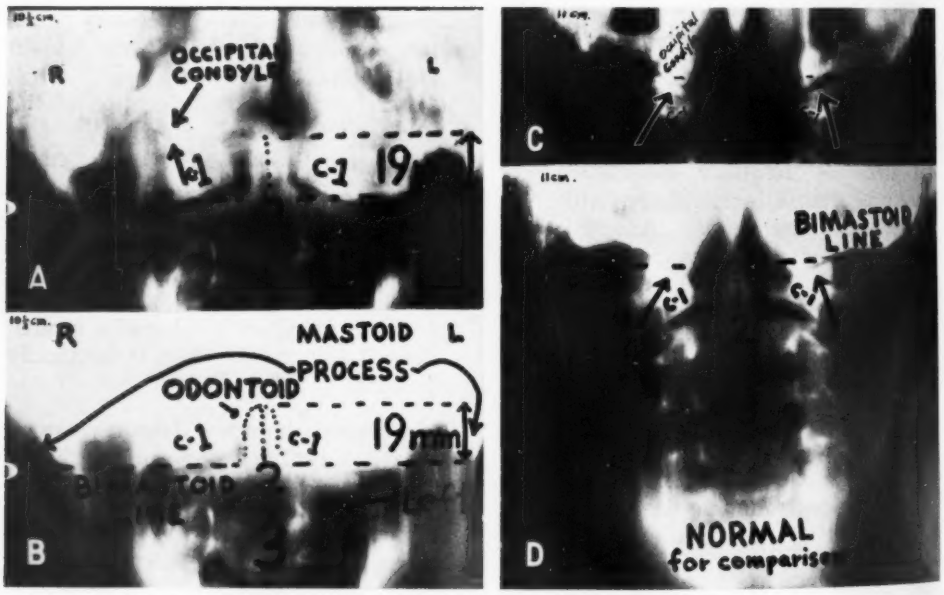
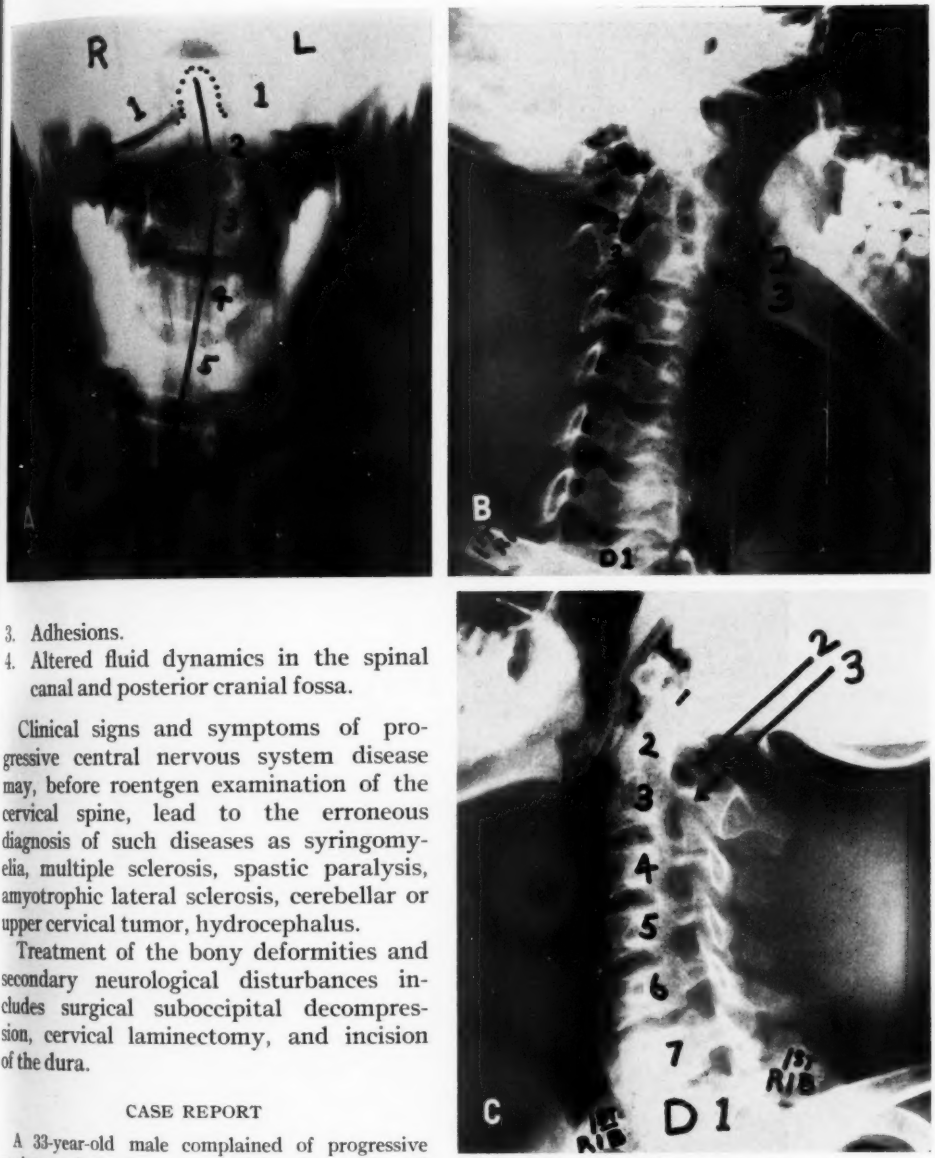


Fig. 2. Tomograms of patient's upper cervical spine in anteroposterior projection (A and B) and anteroposterior tomograms of normal cervical spine for comparison (C and D).

A. Note absence of joint space between occipital condyle and lateral mass of atlas. Only a slight indication of joint space persists.

B. Entire first cervical segment is elevated above the bimastoid line, and the tip of the odontoid projects 19 mm. above this line (upper range of normal, 12 mm.)

C and D. For comparison, normal joint space between occiput and atlas is shown in C and normal relationship between odontoid, first cervical segment, and bimastoid line is shown in C and D.



3. Adhesions.
4. Altered fluid dynamics in the spinal canal and posterior cranial fossa.

Clinical signs and symptoms of progressive central nervous system disease may, before roentgen examination of the cervical spine, lead to the erroneous diagnosis of such diseases as syringomyelia, multiple sclerosis, spastic paralysis, amyotrophic lateral sclerosis, cerebellar or upper cervical tumor, hydrocephalus.

Treatment of the bony deformities and secondary neurological disturbances includes surgical suboccipital decompression, cervical laminectomy, and incision of the dura.

CASE REPORT

A 33-year-old male complained of progressive weakness of the lower extremities, hot and cold flashes in both legs, easy fatigue, and palpitation, experienced for five years. In 1955 the only neurological signs present were bilateral unsustained ankle clonus and plantar flexor responses. Generalized cutaneous tumors and café-au-lait spots, typical of von Recklinghausen's disease, had been present for many years. The patient's mother had similar cutaneous tumors.

Difficulty in walking progressed to the extent that, by July 1959, the patient could walk only half a block, and that not easily.

Fig. 3. Anteroposterior tomogram (A) and both oblique projections of cervical spine (B and C), demonstrating fusion of vertebral bodies and posterior arches of second and third cervical segments. An oval-shaped intervertebral foramen persists bilaterally between the fused neural arches. Angulation to the right (torticollis) is present because the fused segments are higher on the left side.

Preoperative neurologic findings were a spastic gait and severe spasticity of the arms; bilateral foot-drop; grossly increased reflexes throughout the body, including the jaw jerk and bilateral clonus. Position

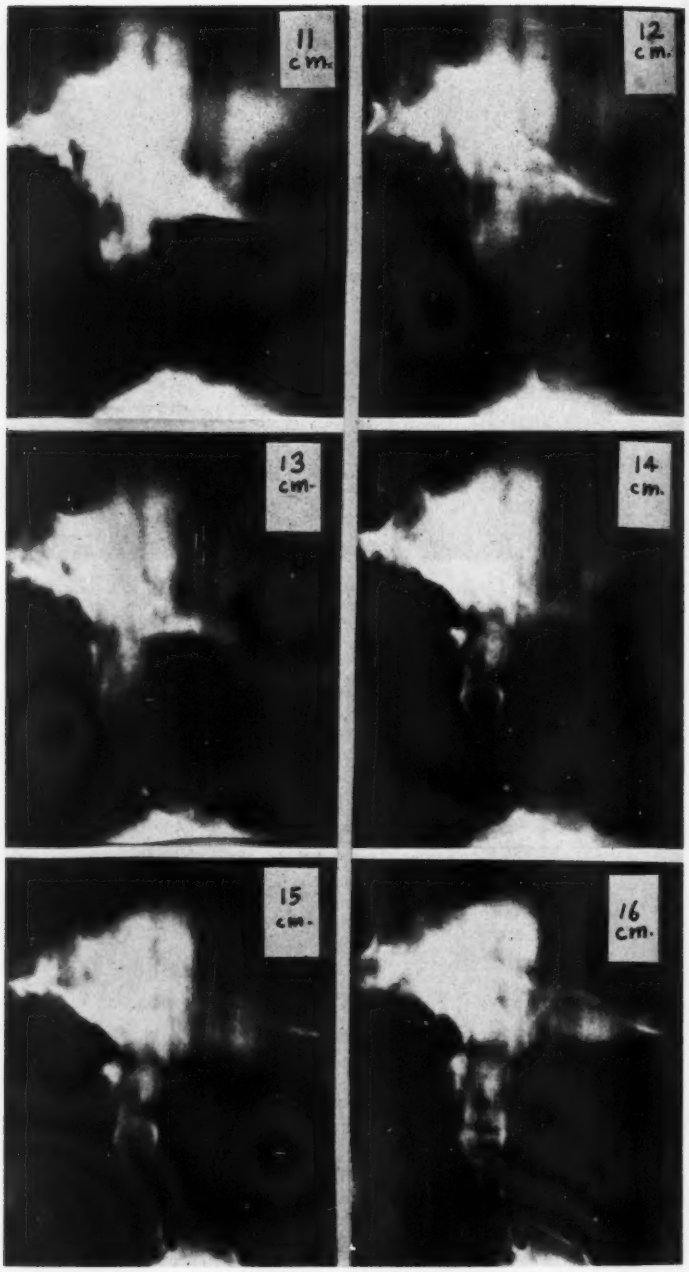


Fig. 4. Tomograms of upper cervical spine in lateral projection. At the 12-cm. level, the arch of the atlas is seen to be fused to the occipital bone. At the 16-cm. level, the opposite half of the neural arch of the atlas is seen to be abnormally small, deformed, and possibly eroded by an adjacent soft-tissue mass lying under the occipital bone. The overlying portion of the occiput is very thin and considerably elevated (see Figure 5).

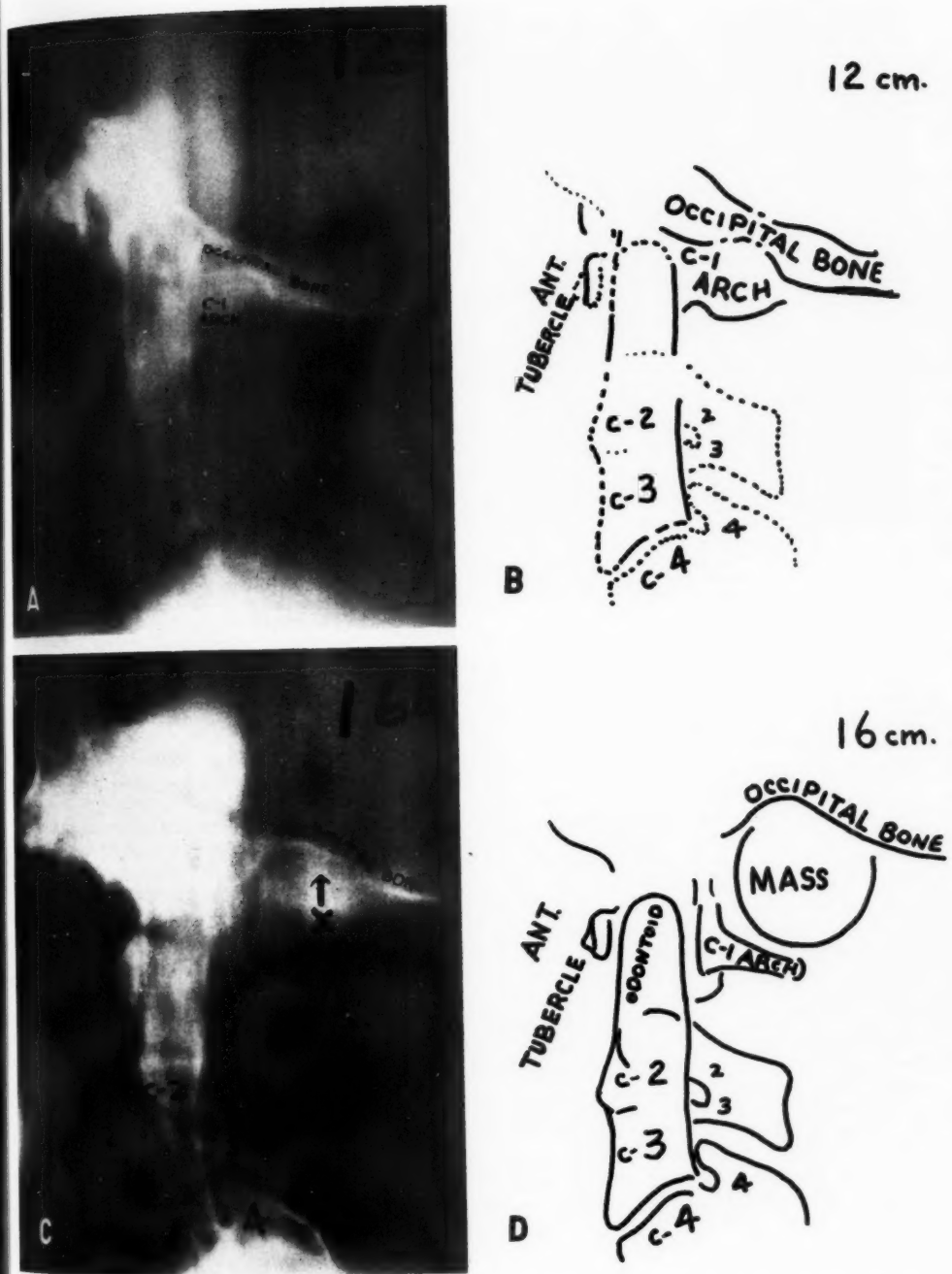


Fig. 5. Tomograms of upper cervical spine in lateral projection and tracings made from the roentgenograms (same films as in Fig. 7). The enlarged images again demonstrate that the arch of the atlas is fused to the occiput (A) and one-half of the first cervical arch is deformed, small, and possibly eroded by an adjacent soft-tissue mass (neurofibroma) located suboccipitally.

C. Elevation of the overlying thinned occipital bone above the neurofibroma.

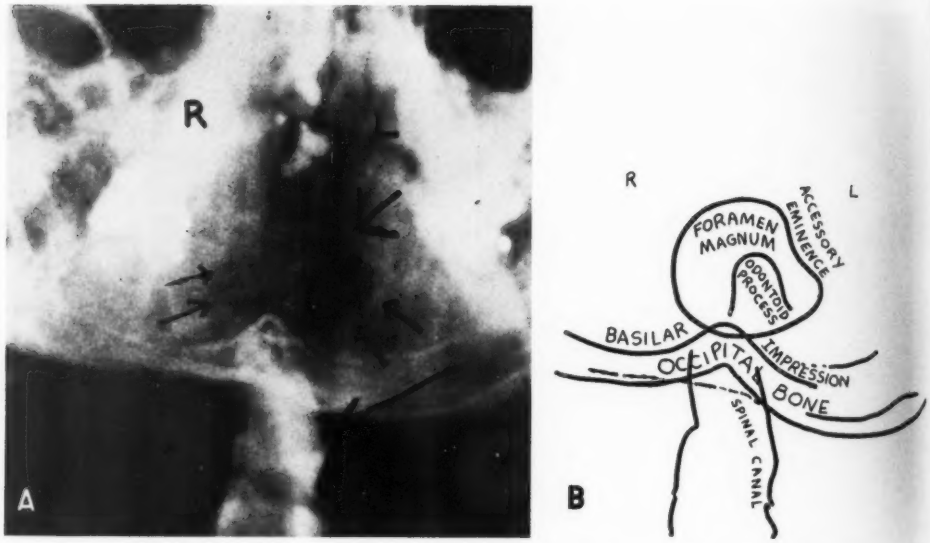


Fig. 6. Fluoroscopic spot-film obtained during cervical myelography (A) and tracings made from roentgenogram (B). The foramen magnum is seen to be deformed by a prominent accessory bony eminence on the left side. The odontoid process and upper end of the spinal canal bear an eccentric relationship to the foramen. The occipital bone is asymmetrical. Funnel-shaped elevation of the occiput surrounding the foramen magnum is indicated by an unusually prominent internal occipital protuberance. Pantopaque entered the basilar cisterns and is shown in droplet form above the foramen magnum.

sense, vibratory sense, and touch sensation were diminished gradually, proceeding distally. In the toes, position sense was almost absent. There was a history of recent urinary incontinence and irregular bowel function.

Roentgenologic Examination: In lateral projections during flexion and extension of the cervical spine (Fig. 1) the neural arch of the atlas was shown not to separate from the occipital bone except for the posterior extremity and the distance between the arch of C-1 and the occipital bone was much less than normal, indicating atlanto-occipital fusion (4, 5). In the anteroposterior projection (Fig. 2), the joint space between the occipital articular condyles and lateral masses of the atlas was almost completely absent. The entire first cervical segment was elevated cephalad and the tip of the odontoid process was projected 19 mm. above the bimastoid line. The upper limit of normal is 12 mm. (1).

Oblique and anteroposterior views (Fig. 3) showed the neural arches and bodies of the second and third cervical vertebrae to be fused without apophyseal joints or disk space between the two segments. A small intervertebral foramen persisted as an oval-shaped "hole" in the fused neural arches. Block vertebrae of C-1 and C-2 were therefore apparent.

Tomograms in the lateral projection of the atlanto-occipital area (Figs. 4 and 5) showed the two lateral halves of the neural arch of the atlas to be asymmetrical, poorly developed, and partially fused to the occiput. A rounded mass, 3 cm. in diameter, was located suboccipitally, and the adjacent half of the first cervical arch was eroded. The occipital bone in this area was considerably elevated and very thin (Fig. 5, C). In the nontomographic lateral view (Fig. 1), mastoid processes overlay the region occupied by the suboccipital mass, obscuring the neurofibroma.

Fluoroscopic spot-films (Figs. 6 and 7) obtained during cervical myelography with 6 c.c. of Pantopaque demonstrated constriction and distortion of the foramen magnum by a prominent bony eminence on the left side, reducing the space offered the spinal cord at its exit from the cranial vault (4). The funnel-shaped occipital bone is seen in the region of the foramen magnum, further evidence of basilar impression (4, 5).

The most cephalad portion of the spinal canal, and the odontoid process also, bore an eccentric relationship to the foramen magnum. This part of the canal was angulated to the right side as was also the upper cervical spinal column. There was asymmetrical development of fused lateral masses of C-2 and C-3, with mild torticollis (Fig. 3, A). The opacified spinal canal displayed no evidence of an intraspinal mass (Fig. 7). Pantopaque entered the basilar cisterns (Fig. 6).

Operative Findings: Laminectomy of the first two cervical segments was undertaken, and a moderate-sized segment of occipital bone surrounding the foramen magnum was removed. The lamina of the atlas was seen to be deformed. Between the occipital bone and the cervical spine was a large pulsating mass containing clear cerebrospinal fluid. This was

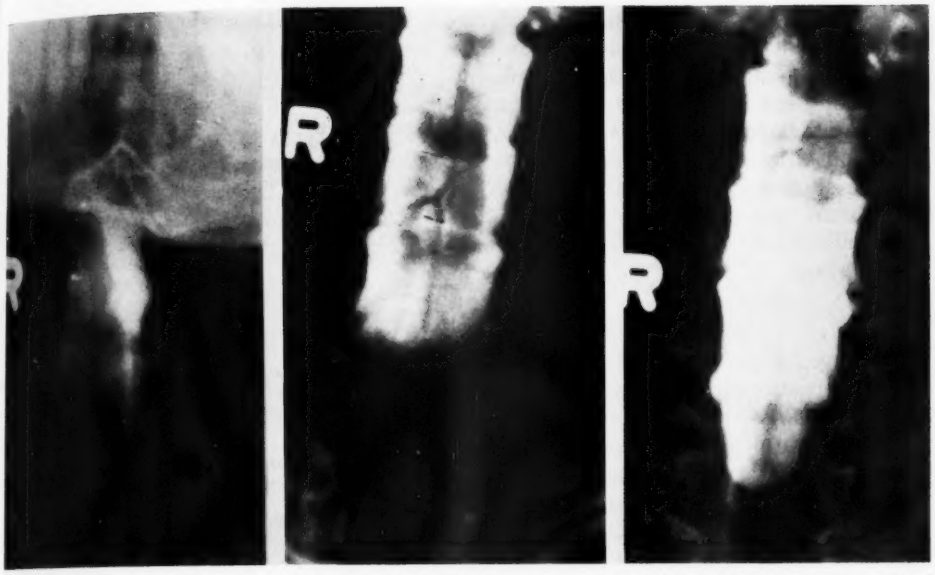


Fig. 7. Cervical myelograms demonstrating only angulation and eccentric relationship of the upper end of the spinal canal associated with torticollis (see Figure 3, A). No evidence of the intraspinal mass. The neck is flexed to obtain suboccipital view (see also Figure 6). The cisterna magna is not filled because the patient is prone.

a meningocele. On the left side was a mass 3 cm. in diameter located suboccipitally in the intraspinal space, extradurally; it did not, however, extend outward through the intervertebral foramen in dumbbell fashion. This mass was removed and proved on microscopic examination to be a neurofibroma. It had displaced the dura of the upper cervical cord to the right and posteriorly.

Ten days postoperatively the patient was considerably improved and ambulatory. There was a marked reduction of spasticity and ability to walk had improved to a notable degree. Six months later he walked easily and well.

DISCUSSION

When symptoms occur as the result of congenital skeletal anomalies in the atlanto-occipital region they are likely to appear late, and the neurological findings can be so nonspecific as to suggest intrinsic disease of the central nervous system instead of underlying deformity of the bony arch surrounding the upper spinal cord. Since surgery is indicated where serious bony deformity has embarrassed the cord, roentgen recognition of the skeletal defects is of more than academic interest.

Previously reported cases of atlanto-occipital fusion with basilar impression were not associated with neurofibromata or meningocele. Numerous patients have had serious neurological impairment, and there have been a number of deaths, as a result of the bony deformity. There were several reasons for our patient's difficulties, namely, an extradural space-occupying mass in the upper cervical area, basilar impression, atlanto-occipital fusion, and deformity of the foramen magnum. Isolated block vertebrae are seldom associated with neurological changes.

Although myelography in this case did not conclusively demonstrate the presence of the intraspinal tumor, the roentgen findings were sufficient to justify laminectomy and surgical decompression at the foramen magnum. While a cervical neurofibroma often extrudes through an intervertebral foramen as a "dumbbell tumor," enlarging the foramen, this process did not occur in the present instance. The neurofibroma here was entirely extradural. Neurofibromas may be located either intra- or extradurally, or both. The meningocele probably developed because of the poorly formed neural arch of the atlas.

Recognition of congenital skeletal abnormality in the upper cervical area is not difficult on plain films. Knowledge of normal anatomy and a routine count of the number of cervical segments with their posterior arches are sufficient to lead to suspicion of abnormal alterations. Additional procedures for confirmation and elaboration of diagnosis can then be undertaken.

SUMMARY

Roentgenologic findings in a patient with atlanto-occipital fusion, basilar impression, and block vertebrae, associated with upper cervical meningocele and neurofibroma, are described and discussed. Importance of early recognition of congenital bony deformity in the region of the foramen magnum is stressed inasmuch as irreparable damage to the upper cervical cord can be prevented by surgical intervention.

The case presented is apparently an isolated instance of serious congenital bony deformities of the upper cervical spine and base of the skull associated with von Recklinghausen's disease, meningocele, and intraspinal neurofibroma.

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SUMMARIO IN INTERLINGUA

Fusion Atlanto-Occipital, Impression Basilar, e Vertebras Blocate, Associate con Neurofibroma Intraspinal, Meningocele, e Morbo de von Recklinghausen

Es presentate un caso que representa apparentemente un isolate exemplo del association de serie congenite deformitates ossee del spina dorsal supero-cervical e del base del cranio con morbo de von Recklinghausen, meningocele, e neurofibroma intraspinal. Proque congenite deformitates ossee in le region del foramine magne pote producer serie injurias in le medulla supero-cervical, lor demonstration roentgenologic deveni specialmente importante.

In le caso hic considerate, le tumor intraspinal non esseva definitemente demonstrate in le myelogramma, sed le constatationes roentgenographic sufficeva a justificar laminectomia e decompression chirurgic. Le associate lesiones esseva revelate al operation.

Le major aspectos roentgenologic de fusion atlanto-occipital es (1) fusion del atlante con le base del cranio, (2) distorsion e constriction del foramine magne, (3) dislocation lateral o anterior del atlante

super le axe, (4) possibilemente non-segmentation infra le fusionate atlante, con torticollis si le vertebras blocate es asymmetric, e (5) le frequente presentia de impression basilar (i.e. elevation del fundo del fossa posterior circum le foramine magne a causa del deformitate fundibuliforme).

Le aspectos neuropathologic associate con le congenite deformitate ossee es (1) compression e destruction del medulla dorsal secundari al impingimento de osso super le foramine magne e le resultante constriction de illo, (2) defective provision vascular del medulla dorsal, (3) adhesiones, e (4) alteration del dynamica de liquido in le canal spinal e le fossa cranial posterior.

Osteoid Osteoma of the Spine

A Cause of Backache and Scoliosis in Children and Young Adults[1]

ROBERT H. FREIBERGER, M.D.

BACKACHE without history of trauma in children and young adults is an uncommon complaint which merits thorough clinical and roentgen evaluation. One cause to which this may be attributable is osteoid osteoma of a vertebra.

Seven patients with vertebral osteoid osteoma were operated upon at the Hospital for Special Surgery (New York) during the past ten years. Five cases were proved histologically; in 2 the nidus was identified by the surgeon in the operating room, but the diagnosis could not be confirmed by the pathologist in the multiple small bone fragments submitted. The condition is not as rare as 7 cases in ten years would seem to indicate, since 5 of these were seen during the past two years and an increasing number have been reported recently (2, 9). In all but 1 of our patients the symptoms had their onset before the age of sixteen, in the youngest at three years. The oldest began to suffer pain at eighteen and was operated upon at twenty.

Osteoid osteoma is a benign but painful lesion. When located in a vertebra, it often produces deformity of the spine, particularly in younger children. Surgical excision is usually followed by immediate relief of pain, with subsequent improvement of the deformities. The possible existence of the condition should be considered whenever signs and symptoms conform to the pattern to be described below.

SIGNS AND SYMPTOMS

The following symptoms, though not specific, should arouse suspicion of an osteoid osteoma: persistent backache, often worse at night, and frequently relieved by small doses of aspirin; mild scoliosis with paravertebral muscle spasm and a list of the spine; localized vertebral or paravertebral tenderness.

One of our patients had a small soft-tissue swelling over the spinous process of the involved vertebra in addition to tenderness over the spine. In every case, temperature, sedimentation rate, and other laboratory tests were normal, and in none was there evidence of systemic disease. Spinal nerve root symptoms were not present in any instance, but have been reported by others, who attributed them to bone changes at the intervertebral foramina (12).

HISTOLOGY

Osteoid osteoma was described by Jaffe (6), who classified it as a benign tumor in 1935. Heretofore the lesion had always been considered as infectious and inflammatory and had been classed with the chronic bone abscesses or Brodie's abscess. Jaffe pointed out that there was no histologic evidence of infection. The tumor consists of an area of more or less calcified osteoid in a stroma of loose, vascular connective tissue without polymorphonuclear or round-cell infiltration. Surrounding this osteoid nidus is a zone of sclerotic but otherwise normal bone. Cultures of osteoid osteomas have not produced consistent growth of organisms. Jaffe's concept of osteoid osteoma is now almost universally accepted.

Spontaneous regression of osteoid osteoma of the long bones has been reported (3, 8). Since the period of pain may be quite long, ranging from two and a half to seven years in the few reported cases, operation with excision of the lesion is the treatment of choice.

[1] From the Hospital for Special Surgery, The New York Hospital-Cornell Medical Center, New York, N. Y.
Accepted for publication in December 1959.

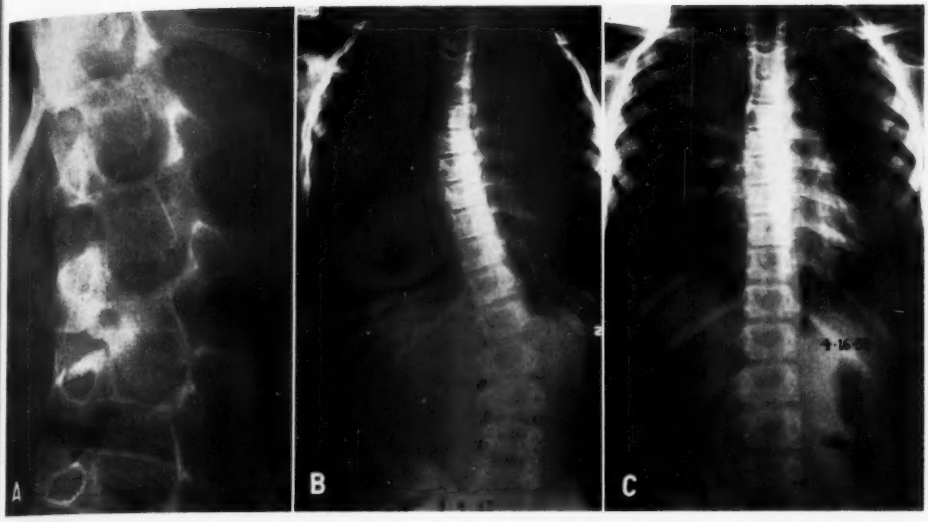

Fig. 1. Case I. A. Preoperative roentgenogram showing sclerosis and expansion of the right lamina of L-2, with a radiolucent nidus within the lamina.
B. Scoliosis, with the patient standing.
C. Roentgenogram made sixteen months postoperatively. The spine is straight, but enlargement of the right transverse process of L-2 persists.

CASE REPORTS

CASE I (Fig. 1): A. T., an 11-year-old boy, was seen at the scoliosis clinic with a deformity of the spine which had been noticed four months previously. The parents stated that he had fallen while roller skating; shortly afterwards they had observed a scoliotic curve and the boy complained of pain in the back. This was not a persistent backache, but was produced by pressure over the spine and by lying flat on the back. Examination revealed a right dorsal left lumbar scoliosis, definite tenderness on palpation over the spinous process of L-2 and L-3, and paraspinal muscle spasm. Neither muscle atrophy nor sensory or reflex changes were present in the lower extremities. The scoliotic curve did not change with bending. Motion of the lumbar spine was limited. A presumptive clinical diagnosis of osteoid osteoma was made and confirmed by x-ray examination, which showed scoliosis, with minimal wedging of vertebral bodies at the apex of the curve, and an area of sclerosis with central radiolucency in the right lamina of L-2.

At operation the right lamina of L-2 was exposed and the area curetted. The lamina was not completely removed. The patient remained in a plaster jacket for approximately three months, completely free of pain. The scoliotic curve did not change appreciably for a period of six months. Postoperative roentgenograms showed the previously described radiolucent area in the sclerotic right lamina of L-2, with a silver clip within it indicating the operative site, but it could not be determined whether the nidus had been completely removed.

Follow-up examination fourteen months after operation showed improvement in the scoliosis, but there were still some muscle spasm in the lumbar area and some restriction of motion of the spine. In a review of the physical findings and roentgenograms sixteen months postoperatively, reoperation was considered because of the persistence of some spinal muscle spasm, restriction of motion, and scoliosis. Since the boy was completely asymptomatic, however, it was decided not to reoperate. Follow-up examinations over the next year and up to twenty-six months postoperatively have shown a steady improvement in the scoliotic curve and in range of motion of the spine. The patient has remained completely free of pain.

Not all of these scoliotic spines improve so slowly. Another four-year-old patient had demonstrable improvement of scoliosis six weeks after excision of an osteoid of the lamina of L-1, and there was a return of normal posture within five months.

CASE II (Fig. 2): G. P., a 12-year-old boy, was seen by Dr. P. D. Wilson in April 1958, because of a six-month history of pain in the neck and a tilt of the head and neck toward the left. The boy had first experienced pain in November 1957, after a fellow player fell on his left shoulder during a football game. This pain, which was located in the neck and shoulder, disappeared promptly but recurred intermittently until January, when it be-

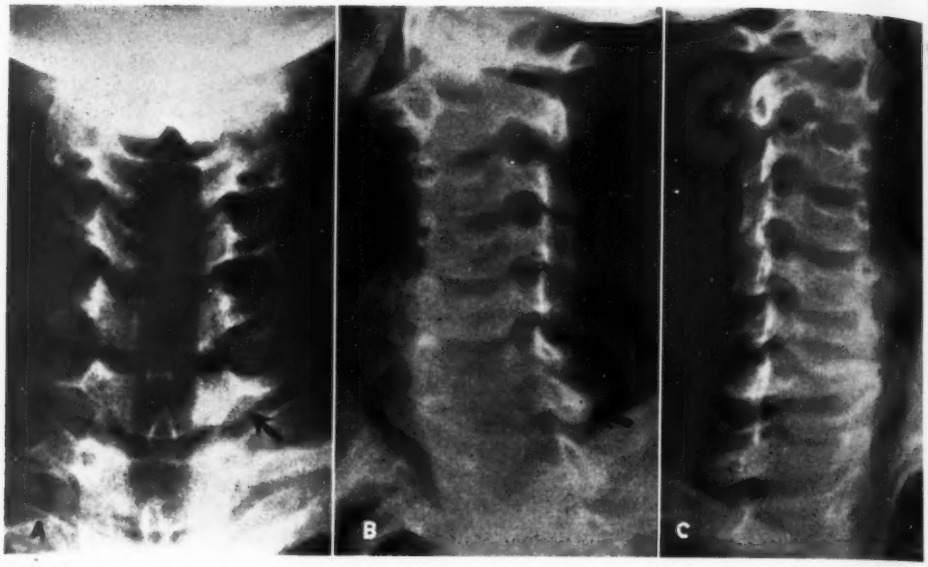

Fig. 2. Case II. A. Anteroposterior view showing small area of increased bone density and expansion of the left lamina of C-7.

B and C. Oblique views showing expansion and sclerosis of left lamina of C-7, particularly striking on comparison with normal right lamina.

came persistent. Treatment by a cervical collar and neck traction produced no benefit, and application of a plaster cast had been considered prior to admission to this hospital.

The boy appeared normally developed and in good health. In the sitting position his chin was rotated slightly to the right and the head was tilted to the left. There was a noticeable right cervical dorsal scoliosis. Flexion and extension of the cervical spine were somewhat limited. A review of anteroposterior and lateral films of the cervical spine, which the patient brought with him, showed a mild scoliotic curve and an area of slightly increased density to the left of the body of C-7. Additional films, including oblique views, revealed sclerosis of the left lamina of C-7, but a nidus could not be shown with certainty. A small radiolucent nidus was demonstrated tomographically, however, lying superficially on the superior margin of the left lamina of C-7.

At operation, after the spinous process of C-7 had been identified by a radiograph in the operating room, its left lamina was exposed. A reddish granular lesion was seen superficially in the superior portion of the lamina, close to the superior articulating process. The lesion was completely excised without disturbing the articular processes, and the major portion of the lamina of C-7 was left intact. Microscopic examination of the specimen revealed the osteoid nidus. Postoperative roentgenograms showed sclerosis of the remaining bone in the affected lamina of C-7, but the nidus could no longer be identified. The patient has been completely free of pain in the eleven months since surgery, and spinal posture has improved.

ROENTGEN EXAMINATION

The roentgen features in osteoid osteoma of the vertebra are similar to those of this lesion when it occurs in other parts of the skeleton. A radiolucent nidus, which may contain a small amount of calcific material, is surrounded by sclerotic bone. In all of our cases the nidus was located in the neural arch or its appendages, but recently a histologically proved osteoid osteoma of the vertebral body has been reported (2). There are usually an area of increased density of bone and an expansion of the lamina and transverse process in the vicinity of the nidus. Although bone sclerosis is generally visible on routine films (anteroposterior, lateral, and oblique views), the nidus may not always be immediately apparent. Since the nidus may not be visible at operation, it is important that the surgeon know its exact location, and spot-films and tomograms in various positions may be required to locate it exactly. All but 1 of our patients had a

mild scoliotic curve, with the concavity of the curve and a list of the spine toward the side of the lesion.

The roentgen diagnosis of osteoid osteoma of the spine may be extremely difficult. One of our patients had two roentgen examinations interpreted as normal. A third examination was performed at the insistence of the examining surgeon, who suspected an osteoid osteoma in the region of L-2, where indeed a nidus was finally located in the articulating surface of the right inferior facet. The surrounding sclerosis was of such mimimal degree that it was hardly apparent on the conventional films.

To summarize, the principal roentgen findings are:

1. Sclerosis of bone in a portion of the neural arch or its appendages and frequently expansion of the vertebral appendage near the radiolucent osteoid osteoma nidus. Bone sclerosis is usually present but may be minimal.

2. A radiolucent nidus. This may require special procedures, such as spot-films in various projections and tomograms.

3. Mild scoliosis with concavity of the curve and a list of the spine toward the side of the lesion.

CONCLUSIONS

Backache, which is an uncommon complaint of children and young adults, usually denotes organic disease. Among other causes, osteoid osteoma must be considered. In the absence of systemic disease, the occurrence of pain in the back, usually worse at night and often relieved by aspirin, a mild scoliotic curve with a list and muscle spasm, and localized paravertebral tenderness should alert the physician to the possibility of osteoid osteoma. X-ray examination must be meticulous; films in multiple projections should be taken, and often tomography will be necessary for accurate localization of the nidus.

The diagnosis of osteoid osteoma will not be made unless pediatricians, orthopedic surgeons, and radiologists are aware that this lesion is not uncommon. Surgical removal of the nidus produces immediate relief of pain, following which the scoliosis improves and may completely subside. It is possible that spinal deformities can become structural and permanent if the nidus is not promptly removed.

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(Pro le summario in interlingua, vider le pagina sequente)

SUMMARIO IN INTERLINGUA

Osteoma Osteoide del Spina Dorsal: Un Causa de Dorsalgia e de Scoliosis in Pueros e Juvene Adultos

Inter le causas de dorsalgia in pueros e juvene adultos, osteoma osteoide debe esser prendite in consideration. Symptomas suspiciose—ben que non specific—es dolores dorsal (usualmente pejor durante le nocte e frequentemente alleviabile per aspirina), un leve curvatura scoliotic con inclino lateral e spasmos muscular, e localisate hyperesthesia paravertebral. Le major constatationes roentgenologic es sclerose del osso in un portion del arco neural o de su appendage, un nido radiolucente, e leve grados de scoliosis. Peliculas a multiple projectiones deberea esser prendite. Tomographia es possibilemente requirite pro localisar le nido accuratemente.

Le ablation chirurgic del nido de osteoma osteoide resultava in le immediate alleviamento del dolores in le 7 casos del autor. Duo del 7 casos es reportate. Meliration del scoliosis sequeva.

Colon Sphincters Simulating Organic Disease[1]

ARCH W. TEMPLETON, M.D.[2]

THIS PAPER is presented to illustrate the difficulty sometimes arising in the differentiation of organic lesions of the colon from localized spasm in the region of the colon sphincters. A frequent finding, during a barium enema examination, is a transient area of narrowing commonly attributed to a spasm. These narrowed segments are generally at the site of documented colonic sphincters. Usually they distend completely without difficulty, but occasionally they persist, in which event their differentiation from organic colon disease is most important.

There are three main types of colon sphincters. The sphincters of Rossi, Balli, and Payr-Strauss participate in nerve reflexes. The Payr-Strauss sphincter is a

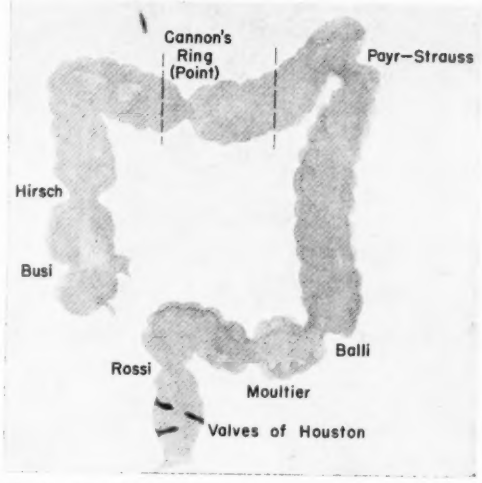

Fig. 1. Location and name of common colon sphincters.

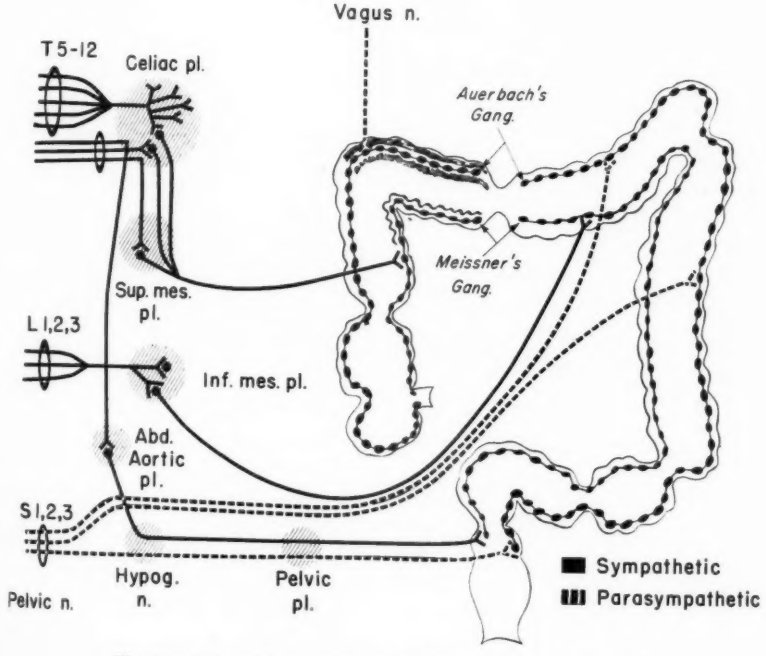

Fig. 2. Autonomic nervous system innervation to the colon.

[1] From the Henry Ford Hospital, Detroit, Mich. Read before the Wayne County Medical Society in Detroit, Mich., December 1959. Accepted for publication in November 1959.

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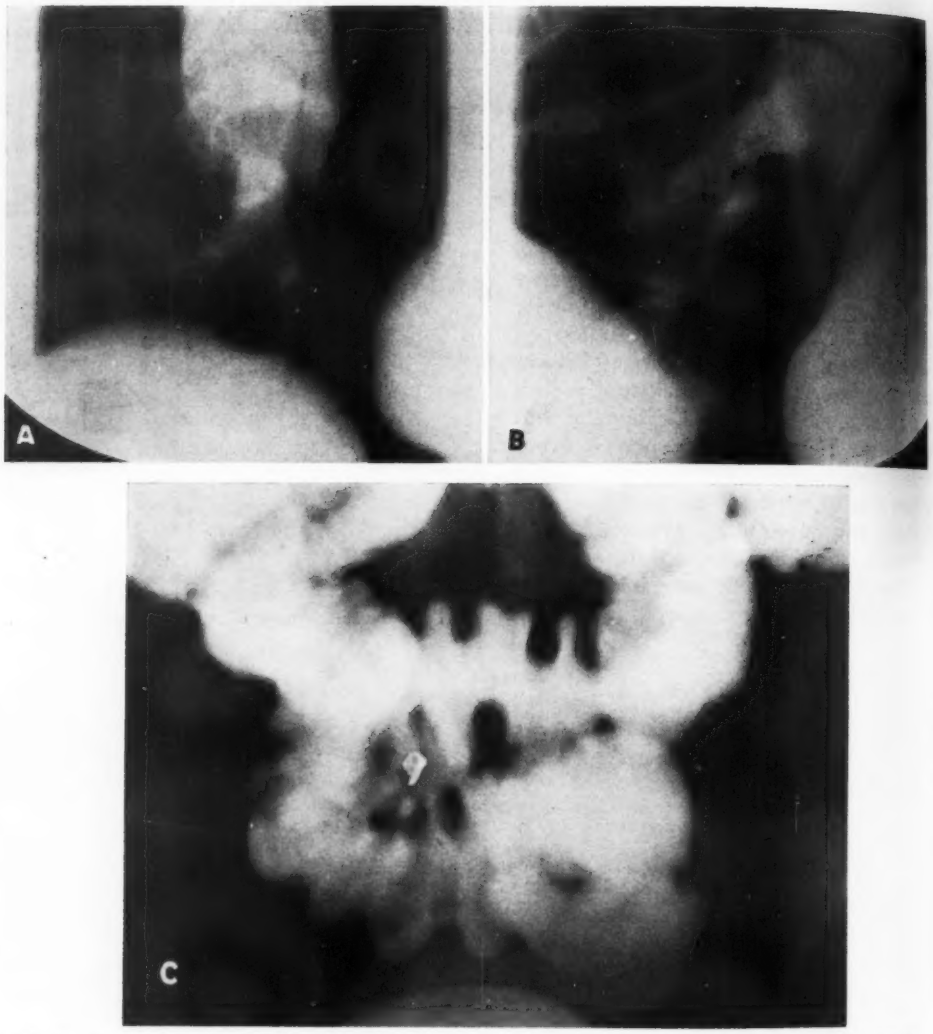

Fig. 3. Case I. A and B. Initial examination, showing a persistent "apple-core" deformity in the sigmoid.
C. Repeat examination (Chassard-Lapine view), negative.

common site of origin for a peristaltic rush after stimulation by the defecation reflex (3). The area of Cannon-Boehm is a second type of sphincter, namely, the apparent overlapping of the superior and inferior mesenteric plexuses. The area of narrowing here is probably due to an imbalance of nerve impulses from the two plexuses (1). In these first two instances, there is no histologic evidence of a special muscular pattern or localized muscular thickening. A third type is represented by the sphincters of Hirsch, Moultier, and Busi. These have been shown to be due to localized thickening of longitudinal and circular muscle fibers (2). Thus, colon sphincters are both anatomic and physiologic in origin.

Figure 1 is a sketch of the colon showing the location of the more commonly visualized colon sphincters. A simplified drawing of the source and distribution of the autonomic nervous system innervation to the colon is given in Figure 2.

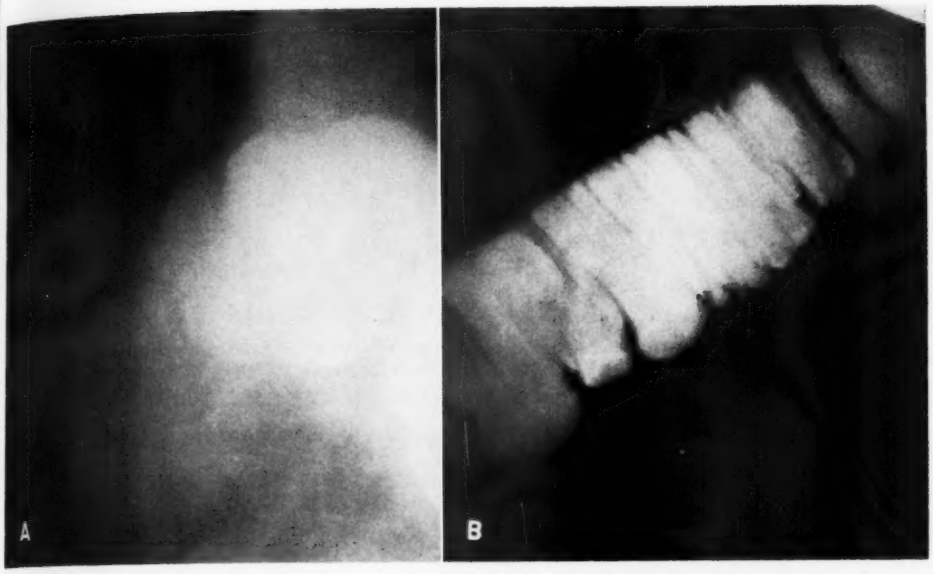

Fig. 4. Case II. A. Initial examination, showing a tapered barium column in the mid-transverse colon.
B. Repeat examination, negative.

In the past few months, there have come to the author's attention 5 cases in which the exclusion of organic colon disease, especially carcinoma, was a perplexing problem. In each case, the initial barium enema study showed an area in which organic disease of the colon was suspected. It was only with repeated follow-up examinations or surgery that the true nature of the condition was identified. In all instances except Case V repeat barium enema examinations were done; Case V went to surgery for excision of carcinoma.

CASE REPORTS

CASE I (Fig. 3): A 55-year-old male gave a six-month history of intermittent episodes of tarry, blood-streaked stools and some recent constipation. The initial barium enema study showed an area of persistent annular constriction and an "apple-core" deformity with possible ulceration in the sigmoid colon. The findings were thought to be due to carcinoma. Repeat examination failed to show any abnormality. There were no diverticula. Note that the originally narrowed area lies in the region of Moultier's sphincter.

CASE II (Fig. 4): A 36-year-old male entered the hospital for a check-up. He had no bowel complaints. At the initial examination, despite all maneuvers, the barium column did not pass beyond the mid-transverse colon. The head of the barium column was somewhat tapered. A subsequent study showed no deformity and demonstrated normal mucosa throughout the transverse colon. In this case, the obstruction to retrograde flow of barium coincided with the sphincter of Cannon-Boehm.

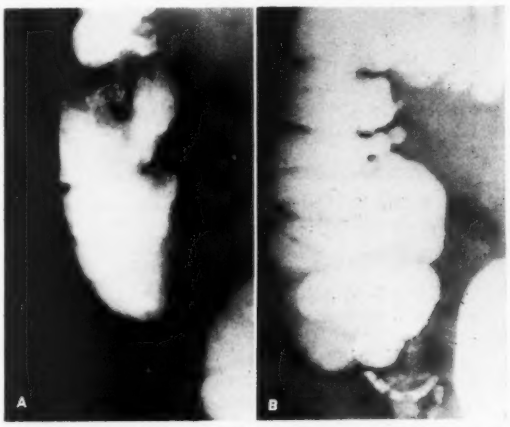

Fig. 5. Case III. A. Initial examination, showing persistent narrowing and shelf formation in the ascending colon.
B. Repeat examination, negative.

CASE III (Fig. 5): A 60-year-old male had a long history of gout and peptic ulcer. The initial barium enema examination showed a persistent constricting lesion in the ascending colon. Its appearance suggested ulceration and shelf formation. A follow-up study a few days later showed no abnormal-

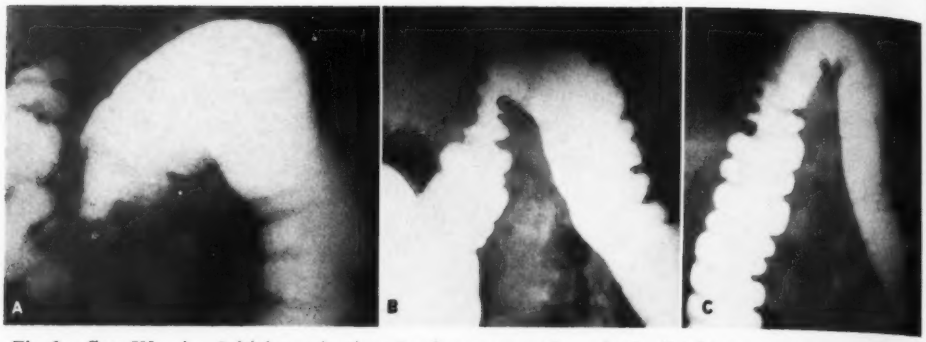

Fig 6. Case IV. A. Initial examination, showing a narrowed area in the distal transverse colon. B. Second examination, showing persistent narrowing, but no ulceration. C. Third examination, negative.

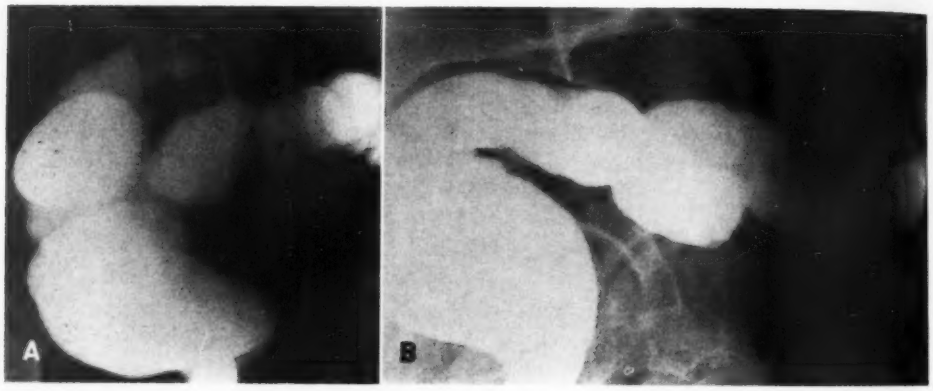

Fig. 7. Case V. A. Initial examination, showing a "napkin ring" deformity in the mid-sigmoid. B. Examination one hour later. The narrowed segment is not demonstrated. This case went to surgery.

ity. It will be noted that the apparent lesion coincides well with the muscular sphincter of Hirsch.

CASE IV (Fig. 6): A 55-year-old diabetic had a two-month history of weight loss, anorexia, and constipation, with intermittent bouts of bloody diarrhea. During the initial barium enema examination, the fluoroscopist noted a persistent, though slightly shifting, segment of narrowing in the splenic flexure and distal transverse colon. This area of narrowing was also seen on the films. On a repeat study the findings were normal. Here the segment of narrowing was in the region of the Payr-Strauss sphincter.

CASE V (Fig. 7): A 70-year-old white male gave a history of progressive constipation for the past three months. A barium enema examination showed a "napkin-ring" deformity in the mid-sigmoid, 2 cm. long. Because of the lack of ulceration and the location of the lesion, additional spot-films were obtained one hour later. Though these failed to show any segment of narrowing, it was felt that the area might have escaped detection, and surgery was undertaken ten days later for possible carcinoma. The operative findings were normal. The deformity as demonstrated by the barium enema study was in the region of Moultier's sphincter.

SUMMARY

A brief review of colonic sphincters is given, with attention to their location and probable source of origin.

Five cases are presented in which organic colon disease, in particular, carcinoma at a sphincter site, was suspected on the initial barium enema study. Subsequent examinations in 4 cases and surgery in 1 failed to demonstrate any abnormality. The segments of narrowing must, in each

instance, have been due to persistent spasm in the region of a colonic sphincter.

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SUMMARIO IN INTERLINGUA

Sphincteres del Colon, Simulante Morbo Organic

Es presentate un breve revista del sphincteres colonic. Isto es sequite per le presentation de 5 casos in le quales—super le base del studio a barium initial—un morbo organic del colon, specificamente carcinoma, esseva suspicite al sito del sphincter. Le examines subsequente in 4 del casos e le intervention chirurgic in le quinte non demonstrava le defecto originalmente observate. Le colon pareva normal. Le segmentos de constriction in omne iste casos debe haber resultate de un persistente spasmo in le region del sphincter colonic.

Bone Sclerosis in Multiple Myeloma[1]

EDWARD P. ENGELS, M.D.,[2] ROBERT C. SMITH, M.D.,[3] and SIMON KRANTZ, M.D.

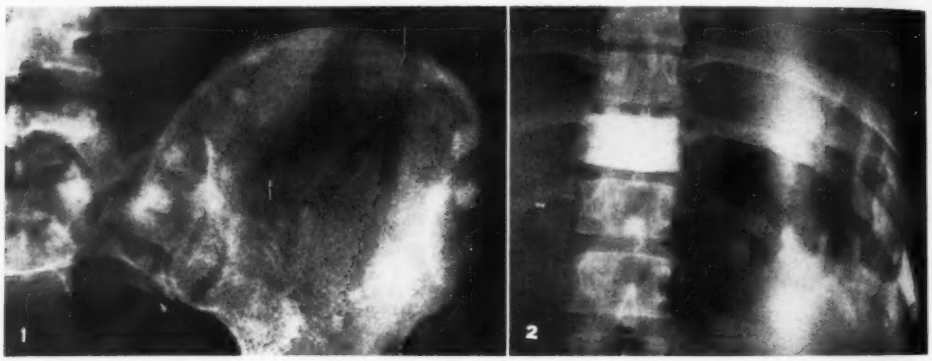
THE RARITY of roentgenographically demonstrable sclerotic lesions of bone in multiple myeloma is attested by the infrequent mention of this finding in radiologic textbooks and by the small number of reports in the literature.

Schinz, Baensch, Friedl, and Uehlinger (13) state that multiple myeloma produces rounded, sharply demarcated bone defects of various sizes without marginal reaction. The most useful point in diagnosis, according to Shanks and Kerley (11) is, local osteoporosis, with no bone of normal density visible in the affected regions. Brailsford (2) states categorically that "the adjacent bone shows no reaction."

The literature contains occasional reports of bony sclerosis in multiple myeloma. Rypins (10) recorded the case of a 21-year-old woman with multiple myeloma proved at autopsy, who had subcutaneous nodules and numerous areas of osteosclerosis and osteolysis in the femurs, pelvis, and hand. "Whiskers" of new bone were laid down perpendicular to the shafts of the bones in some areas.

The occurrence of an osteoblastic lesion in the left humerus in a 68-year-old woman was reported by Krainin, D'Angio and Smelin (7). The typical sunburst appearance of a malignant bone tumor was present in this case, as well as zones of osteolysis in the skull, pelvis, clavicles, and right humerus. A biopsy revealed periosteal new bone reaction to myelomatous infiltrations and extensive replacement of marrow by myeloma cells. The peripheral blood contained a significant number of plasma cells and the case was considered one of plasma-cell leukemia. A similar case with plasma cells in the peripheral smear was reported by Sharnoff *et al.* (12), in a 68-year-old man with multiple myeloma and osteosclerotic lesions in the lumbar spine, pelvis, and ribs similar to "osteoblastic cancer metastases."

Kohler and Laur (6) described a 65-year-old woman with proved multiple myeloma, who presented a dense osteoblastic focus in the left ilium. All other causes for osteosclerosis were excluded. These writers were able to collect from the literature 179 cases of multiple myeloma. Among these were 4 with bone sclerosis, following irradia-



Figs. 1 and 2. Case I: Sclerotic nodules in ilium and lumbar spine (Fig. 1); sclerotic vertebra and sclerosis and nodules of ribs (Fig. 2).

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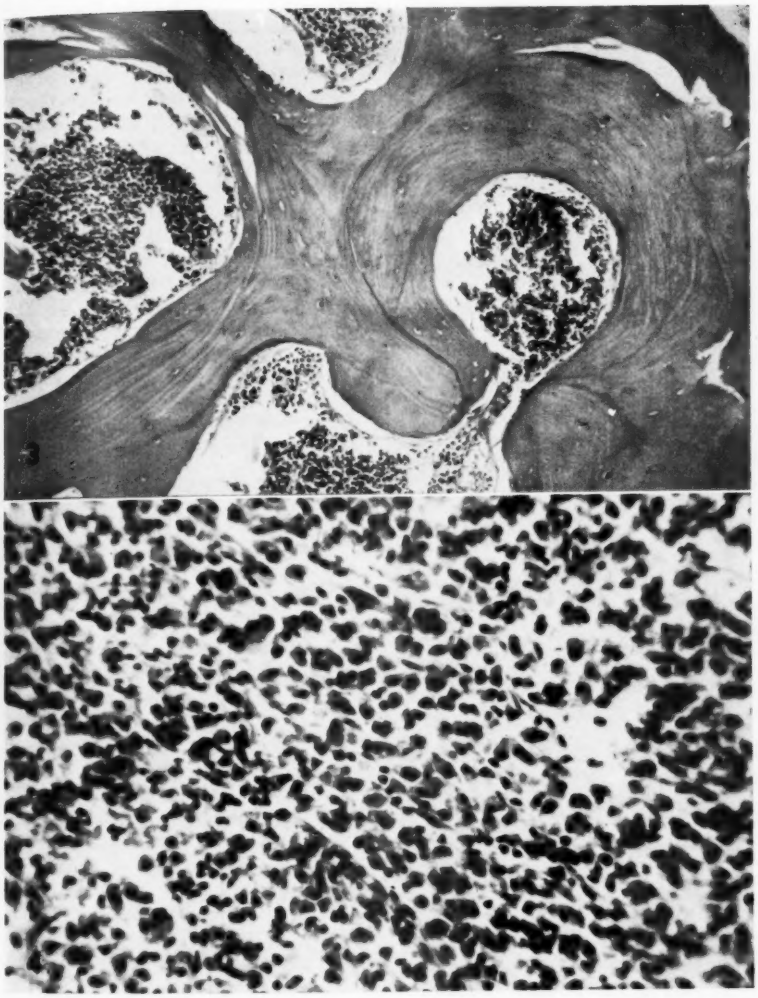


Figs. 3 and 4. Case I: Sections prepared from dense sclerotic rib lesion.
Fig. 3. Bony trabeculae are broad, intact, and laminated; the marrow spaces are cellular, marrow architecture is lost, and fat is absent.
Fig. 4. The marrow space is occupied by a sheet of plasma cells, some of which are atypical. Nuclei are eccentric in position. There is no fat; hematopoietic elements are scant. (J. Mendeloff, Chief of Pathology, VA Hospital, Atlanta, Ga.) Hematoxylin and eosin. ×537.

tion of an osteolytic area in 2 instances. One of these 4 cases was that of Bailey (1), in a 65-year-old white male with a solitary myeloma of the right humerus treated by irradiation. Six years later a sclerotic reaction was seen in the shaft of the humerus. Recalcification is seldom noted, however, after radiation therapy of myelomatous foci or after treatment with urethane (3, 9).

Odelberg-Johnson reports a case of myelomatosis in which roentgen examination revealed progressive and widespread, circumscribed osteosclerosis resembling metastasis but no evidence of osteolysis (8). The patient had never received roentgen therapy. Microscopic examination showed "many coarse bone-trabecules at the site of these lesions. Between the trabecules were abundant plasma cells.

Fig. 5. Case II: Perpendicular bony spicules in cranial vault involvement.

There was cancellous bone outside the osteosclerotic areas containing fine bone trabecules and the bone marrow was rich in cells."

Galgano (5), in a review of unusual features of multiple myeloma, mentions a 69-year-old man with soft-tissue and bone infiltrations. A histologic diagnosis of multiple myeloma was made by biopsy of a skull lesion. Later an osteolytic and osteoblastic lesion of the first lumbar vertebra developed.

We are reporting 3 additional cases of unusual bone sclerosis in association with multiple myeloma. Complete postmortem material reaffirmed the original diagnosis of multiple myeloma in each instance and no coexistent malignant tumor was found.

CASE REPORTS

CASE I: A 36-year-old white male was admitted to the Atlanta Veterans Administration Hospital, complaining of swelling of the feet for six months. Clinical findings and electrocardiography indicated constrictive pericarditis. Roentgenograms revealed numerous osteosclerotic lesions of the pelvis (Fig. 1), "ivory vertebra," and sclerotic involvement of the ribs (Fig. 2) There were no symptoms from the bone involvement.

Laboratory Studies: The hemogram was normal, with slight relative lymphocytosis. The total protein was 6 grams; albumin 3.5 grams; calcium 9.4 mg. per cent; inorganic phosphorus 4.7 mg. per cent; acid phosphatase 1.6 Bodansky units; alkaline phosphatase 2.4 Bodansky units. Plasma electrophoresis revealed a small abnormal peak in the gamma fraction compatible with multiple myeloma. A biopsy of the left twelfth rib showed dense sclerotic bone in which plasma cells were conspicuous (Figs. 3 and 4). It was the opinion of the pathologist that multiple myeloma was the most likely possibility in spite of the atypical pattern.

Progress: Irreversible severe congestive heart failure and anasarca unresponsive to therapy developed, and death occurred three and one-half months after admission.

Autopsy: Postmortem examination supported the clinical and x-ray findings and disclosed a pericardial effusion of 1,500 c.c. There was myelomatous involvement of the epicardium microscopically. No evidence of primary cancer of the prostate or other organs was found.

The final histologic diagnosis was plasma-cell myeloma, diffuse.

CASE II: A 40-year-old white male entered the Veterans Administration Hospital, Bay Pines, Fla.,[4] with a history of subcutaneous masses involving the right shoulder, the base of the neck anteriorly, and the right hand. These had developed slowly over the past year. Another mass appeared near the vertex of the skull. A tangential view of this lesion showed new bone production in the skull, adjacent to the mass (Fig. 5). Roentgenograms of the chest and pelvis revealed an unusual dense appearance of bone similar to that seen in myelosclerosis or in Albers-Schönberg disease (Fig. 6).

Laboratory Studies: The hemogram was normal. No Bence-Jones protein was demonstrable in 3 twenty-four-hour urine specimens. Total protein was 13.6 grams; albumin 4.1 grams; globulin 9.5 grams; calcium 10.7 mg. per cent; inorganic phosphorus 4.5 mg. per cent; acid phosphatase 0.7 Bodansky units; alkaline phosphatase 3.4 Bodansky units. Biopsy of a subcutaneous mass over the xiphoid was reported as "plasmacytoma." A sternal aspiration showed 35 per cent plasma cells in the marrow, some of which were immature and multilobated.

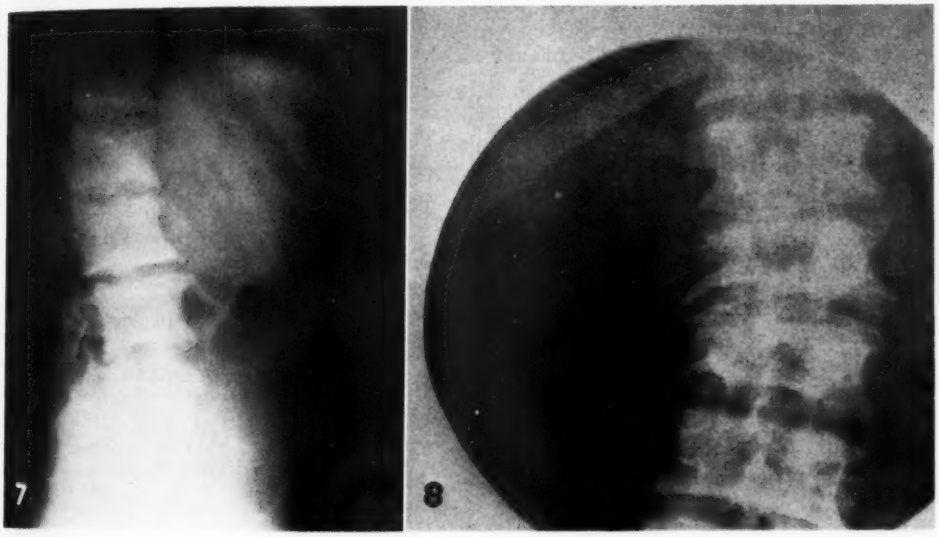
Autopsy: The patient died of septicemia and bilateral upper lobar pneumonia. Gross findings at

[4] Courtesy of Dr. Harold Feld, Chief of Radiology, VA Hospital, Bay Pines, Fla.

autopsy included large, firm, grayish masses in the ribs, the largest measuring 5 cm. in diameter. Histologic study showed infiltration of the sternum, ribs, vertebrae, pelvis, testes, and inguinal and iliac nodes with plasma cells. Large para-amyloid deposits were noted in the ribs. Sections are available through these amyloid accumulations but unfortunately there are no slides of the bone not showing amyloid.

CASE III: A 65-year-old white male was admitted to the Grady Memorial Hospital, Atlanta, Ga.,[5] with a history of anorexia and intermittent sharp pains in the upper right abdominal quadrant of one month duration. Roentgenograms revealed atelectasis of the right lower lobe and a peculiar granular osteoporosis of the ribs with fusiform and cystic swellings, notably of the left posterior sixth rib. The vertebrae and skull appeared sclerotic (Figs. 7 and 8).

Fig. 6. Case II: Uniform sclerosis of pelvis and femora.



Figs. 7 and 8. Case III: Sclerotic lumbar vertebra.

Laboratory Findings: The Bence-Jones test was negative on 2 twenty-four-hour urine specimens. Total protein was 9.6 grams; calcium 8.7 mg. per cent; phosphorus 2.9 mg. per cent; alkaline phosphatase 1.3 Bodansky units. The Sulkowitch test was negative. A biopsy showed "large areas of densely packed cells composed almost entirely of plasma cells. The nuclei vary considerably in size and occasional multinucleated elements are seen." One of the bone sections revealed broad trabeculae, somewhat larger than normal. The marrow space contained increased numbers of plasma cells.

Autopsy: The patient died of acute purulent meningitis and bronchopneumonia. At autopsy pale, focal, nodular areas were seen in the ribs, vertebral bodies, and sternum. Microscopic examination showed these areas to be composed of large accumulations of multinucleated plasma cells. Amyloid material was not present. There was no evidence of bony spicule erosion or replacement.

[5] Courtesy Dr. H. S. Weens, Professor of Radiology, Emory University School of Medicine, Atlanta, Ga.

DISCUSSION

Three cases of unusual sclerosis associated with multiple myeloma are presented above. Postmortem examinations failed to disclose any other primary neoplasm.

In Case I, there were focal nodular areas of sclerosis with an "ivory" vertebra, giving an appearance similar to metastatic

prostatic carcinoma. In the second case, there was, in addition to the dense sclerotic bone of the pelvis and spine, an area of new bone production in the skull with some perpendicular striations, such as is seen with osteogenic sarcoma. Generalized, fairly uniform sclerosis was shown in the third case.

Histologic examination of these various areas of involvement showed thickened bony trabeculae around groups of plasma cells. The plasma cells were increased in size and were multinucleated. In arriving at a diagnosis, one must take extreme pains to exclude carcinomatosis or other diseases capable of producing plasmacytosis. Fadem and McBirnie (4) mention a significant increase in plasmacytic elements in the bone marrow above that considered diagnostic for primary plasmacytic disease as occurring in Hodgkin's sarcoma, lymphosarcoma, acute monocytic leukemia, primary refractory anemia, papilloma of the urinary bladder, and in a case of hiatal hernia. In our cases there was no evidence of any of these diseases.

Schinz *et al.* (13) have pointed out that "the classical criteria for the diagnosis of plasmacytoma will fail if the excretion of amyloid occurs within the plasmacytoma." The roentgenograms in these instances are characterized by spotted areas of bony destruction with intensive endosteal and periosteal marginal reaction. In our second case, amyloid deposits were found in the soft-tissue masses and in the ribs. We do not believe, however, that these paraamyloid deposits can be reconciled with the osteosclerosis noted on roentgenograms in this patient.

CONCLUSIONS

Osteoblastic metastatic lesions are not, as a rule, associated with multiple myeloma.

1. Three proved cases of multiple myeloma which exhibited essential osteosclerotic lesions without evidence of the typical osteolytic lesions usually seen in multiple myeloma are presented.

2. The histologic appearance of the bones in the areas of involvement showed thickened trabeculae surrounding islands of plasma cells, many of which were undifferentiated.

3. There is no good explanation for the production of osteosclerosis in multiple myeloma.

4. Some cancers and other diseases will occasionally show a relative plasmacytosis. It is necessary, therefore, to differentiate such a process from true plasmacytosis. As a rule, this is not a difficult problem.

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SUMMARIO IN INTERLINGUA

Sclerose Ossee in Myeloma Multiple

Es presentate tres casos de un sclerose inusual, associate con myeloma multiple. Examines post morte non revelava ulle coexistente cancere primari. In le prime caso, nodular areas focal esseva trovate con un vertebra de "ebore" de apparentia simile a metastases de carcinoma prostatic. Le secunde caso monstrava—a parte le dense osso sclerotic del pelve e del spina dorsal—un area de neoformation de osso in le cranio, con un certe numero de striationes del typo vidite in sarcoma osteogene. In le tertie caso il habeva generalisate e satis uniforme sclerose.

Sectiones histologic del ossos in le areas afficite monstrava spissification del trabeculas circumdante insulas de plasmocytos. Multes de istos non esseva differentiate. Il non existe un bon explication pro le production de osteosclerosis in iste casos.

Puncture of the Thoracic Lymph Duct with Chylothorax: A Rare Complication of Aortography[1]

ENRIQUE SCHWARZ, M.D.[2]

THERE HAVE appeared a considerable number of reports on complications of translumbar aortography. The present paper deals with a case of accidental puncture of the thoracic duct during attempted aortography. While this type of complication has been reported rarely, awareness of its possibility is essential.

CASE REPORT

A 50-year-old white man with advanced arteriosclerosis was admitted for evaluation of an ischemic left lower limb and intermittent claudication. Six years prior to admission he had been in congestive failure; at that time diabetes and hypertension were diagnosed. During the last three years he had suffered symptoms of intermittent claudication, and, one week before admission, bluish discoloration and pain in the left fourth toe were noted. On examination the blood pressure was found to be 150/110, the heart and liver were enlarged, the popliteal pulses were weak, and the dorsalis pedis pulsations were absent. Signs of arteriosclerosis were present in the corneal vessels, and there were electrocardiographic alterations. A left lumbar sympathectomy was performed three days after admission. There were no complications and the condition of the left foot improved. Six days later,

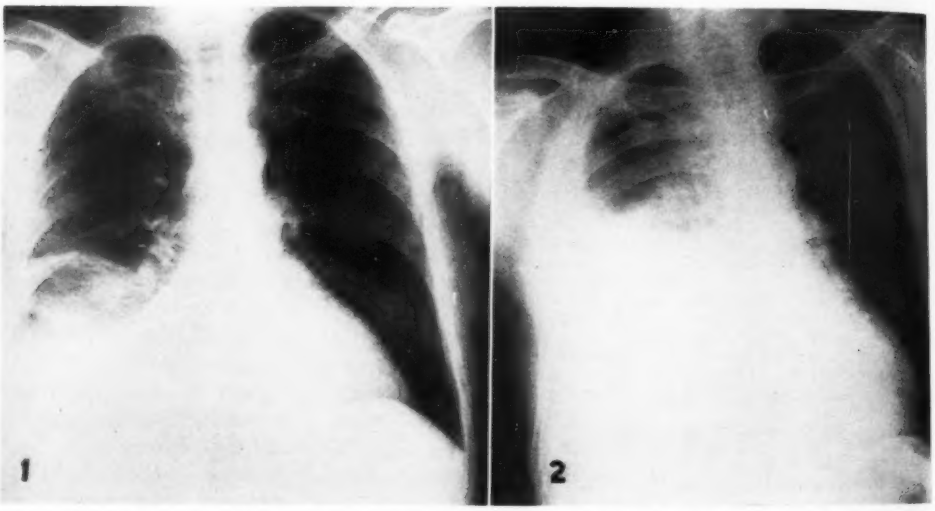

Fig. 1. Roentgenogram of the chest taken two days after aortography. There is evidence of a large right pleural effusion. The admission chest film was normal.

Fig. 2. Four days later, a massive pleural effusion is demonstrated, extending up into the right upper lobe area.

A thorough survey of complications of abdominal aortography was published by McAfee after a review of 13,207 replies to questionnaires from 301 hospitals. Among the cases thus collected were several fatalities, indicating that the procedure is not an inconsequential one. While admitting that complications of abdominal aortography cannot be wholly eliminated, McAfee offers some suggestions for their avoidance that should be useful to all those concerned with the performance of this now widely employd examination.

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translumbar aortography was attempted but proved to be unsuccessful. Two days thereafter, severe chest pain, dyspnea, and cyanosis developed, and a right pleural effusion was apparent on radiographic examination of the chest (Fig. 1). The patient became increasingly dyspneic, and thoracentesis was necessary to relieve his symptoms. A massive right pleural effusion was demonstrated radiographically six days after aortography (Fig. 2), and 17,600 c.c. of chylous fluid was obtained during the next thirteen days. Thoracotomy was felt to be necessary for ligation of the thoracic duct and control of the loss of chyle.

At surgery, 1,300 c.c. of milky fluid was removed on entrance into the right pleural cavity. A small defect was discovered in the mediastinal pleura at the level of T-10, and from this area fluid was seen to escape. A distinct opening was found in the thoracic duct, with chyle escaping through it. Ligation was performed above and below the opening. The x-ray examination of the chest after the operation revealed normal aeration of the right lung field. Five days later the patient became cyanotic, and the blood pressure and pulse were unobtainable. An electrocardiogram showed auricular fibrillation and left bundle branch block. In spite of therapy, death occurred the same day.

The immediate cause of death as determined by autopsy was coronary insufficiency. The heart showed ventricular dilatation, and generalized arteriosclerosis with left coronary artery obstruction was found. There was mild pulmonary edema, and splenic and renal infarcts were present.

DISCUSSION

The accidental puncture of the thoracic lymph duct during translumbar aortography is a rare but serious complication. Only one report was found in the literature of complete severance of the duct (Maluf and McCoy). This complication may result in massive accumulation of chylous fluid within the pleural cavity and the development of dyspnea due to the mechanical effects resulting from compression of the lung, reduction in vital capacity, and perhaps mediastinal shift with angulation of the blood vessels. Multiple thoracenteses are required, as the output of lymph from the duct is said to be about 60 to 190 c.c. per hour.

This accident may be due to improper direction of the needle, which enters the posterior abdominal wall too far laterally and, without puncturing the aorta, passes between it and the vertebral column reaching the thoracic duct. It is also possible that an anatomical variation in the duct may be present to account for the accidental puncture. The lymph duct normally ascends through the posterior mediastinum between the aorta and azygos vein and at the level of T-5 it inclines to the left side and enters the superior mediastinum. If the duct inclines to the left at a lower level, a needle introduced at that point will reach it easily before entering the aorta, especially if the needle enters the posterior wall too far laterally, as shown in Figure 3.

Knowledge of the anatomy of the region to be approached and careful puncture of the body wall are essential to avoid this complication.

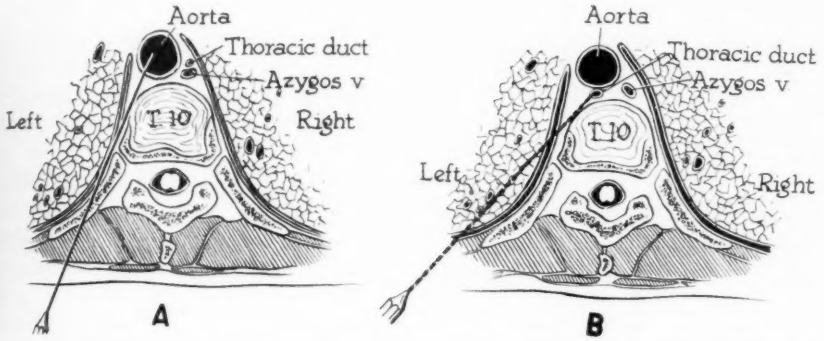

Fig. 3. A. The normal direction of the needle reaching the aorta. B. Theoretical change in the direction of the needle entering the wall too far laterally. The thoracic duct is shown behind the aorta. The needle reaches the duct before entering the aorta.

In the case reported here, the complication was not apparently the direct cause of death. We believe that the previously existing condition of the patient may have been aggravated by the procedure, resulting in death from coronary insufficiency. A careful evaluation of the history and consideration of the possible complications involved in the procedure are mandatory before submitting any patient to the risks of translumbar aortography.

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SUMMARIO IN INTERLINGUA

Punctura del Ducto Thoracic, con Chylothorace: Un Complication Rar de Aortographia

Es reportate un caso de punctura accidental del ducto thoracic durante le tentativa de effectuar aortographia. Le patiente moriva, in consequentia de insufficientia coronari. Es opinate que le pre-existente condition esseva aggravate per le punctura del ducto thoracic.

Isto es un complication rar sed grave, resultante in un accumulation massive de liquido chylose intra le cavitate pleural, con disveloppamento de dyspnea in consequentia del effectos mechanic que resulta in le compression del pulmon, in un reduction del capacitate vital, e forsan in un displaciamento mediastinal con angulation del vasos de sanguine.

Le accidente pote esser le resultato de un incorrecte direction del agulia o, forsan, de un variation anatomic.

Un caute evalutation del historia del patiente e le consideration del possibile complicationes de aortographia translumbar es indispensabile ante que un subjecto es submittite al risco de iste procedimento.

SUMMARIO IN INTERLINGUA

Chylothorace: Un Complication de Aortographia Translumbar

(*Pagina 251*)

Chylothorace es un complication inusual de aortographia translumbar. Illo deberea esser suspicite quandocunque complicationes respiratori se disveloppa post le intervention.

Es revistate duo previemente reportate casos de chylothorace post aortographia. Es presentate hic un tertie caso que esseva diagnosticate precocemente, tractate sin successo per repetite thoracenteses, e ducite a un bon responsa per thoracotomia claudite. Le difficultate del entrata in le aorta—necessitante un multiple avantiamento del agulia—esseva un aspecto que le 3 casos habeva in commun.

Le roentgenogramma initial in le caso del autor haberea potite esser interpretate incorrectemente como un elevation del hemidiaphragma dextere, proque le liquido esseva localisate in un sito infrapulmonar.

Chylothorax: A Complication of Translumbar Aortography[1]

LIEUT. COL. FERRIS E. COOK, JR., LIEUT. COL. ROBERT A. FLAHERTY,[2]
MAJ. CHARLES L. WILLMARTH,[3] and MAJ. PAUL R. LANGELIER, USAF (MC)

PULMONARY complications of translumbar aortography have been few in number since its popularization as a diagnostic test. McAfee (1), in his *Survey of Complications of Abdominal Aortography* in 1957, listed symptomatic pneumothorax in 4 cases, symptomatic hemothorax in 3, acute respiratory failure and asthmatic attack in 1 each, and chylothorax in 2 cases.

Anatomically, the thoracic duct begins in the abdomen as the cisterna chyli, which is situated on the front of the body of the second lumbar vertebra, to the right of and behind the aorta. It enters the thorax through the aortic hiatus of the diaphragm and ascends through the posterior mediastinum between the aorta and azygos vein. Its diameter is variable and it is usually more easily demonstrated in the cadaver than on the operating table, unless an obstruction is present superiorly. Anterior to the thoracic duct, in the region of aortography, is a recess of the right pleural cavity separating the duct from the pericardium. Thus it is anatomically possible, during aortography to perforate, tear, or sever the thoracic duct and perforate or tear the pleura of the right pleural cavity, creating a situation which could result in chylothorax.

Maluf and McCoy (3) recorded the first case of chylothorax complicating aortography in April 1955. The operator advanced the needle too laterally, passing between the aorta and spine, severing the thoracic duct at the level of T-10–T-11, without perforating the aorta. Twenty-four hours later 1,500 c.c. of lymph was aspirated from the pleural cavity. Thoracotomy with ligation of the duct was performed within forty-eight hours and the patient recovered completely.

Gaspar and Secrest (4) reported the second case of chylothorax occurring during attempted aortography in August 1957. Routine advancement of the needle was carried out under general anesthesia. The aorta was entered on the third attempt. The patient was discharged from the hospital the next day, but returned on the fourth day complaining of substernal tightness, cough, mild dyspnea, and pain in the right side of the chest on deep breathing. A roentgenogram revealed a moderate right hydrothorax and mild left hydrothorax. Right thoracenteses were performed on the fourth, eighth, and twelfth post-aortography days with recovery of 1,650, 1,900, and 2,500 c.c., respectively, of milky fluid. On the fourteenth day, a right thoracotomy was performed and a tributary of the thoracic duct was found to be partially severed. This and the thoracic duct were individually ligated, and the thorax was closed without drainage. The postoperative course was uneventful and a chest roentgenogram was essentially normal six months later.

A 44-year-old white female with a history of a right nephropexy and nephrostomy in 1947, and a left pyeloplasty and nephrostomy in 1949, had continued to have intermittent urinary tract symptoms and signs following surgery, notably right flank pain, dysuria, urgency, burning on urination, and fever. Because of the persistence of right-sided symptoms and evidence of decreased function of the right kidney on an excretory urogram, she had been advised elsewhere to have a right nephrectomy.

On June 8, 1958, the patient was seen in the Lackland Air Force Base Hospital for the first time. Her complaints were suprapubic pressure-like pains,

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The contents of this paper reflect the personal views of the above authors and are not to be construed as a statement of official Air Force policy.

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Fig. 1. Aortogram demonstrating leaves of diagram in normal position.

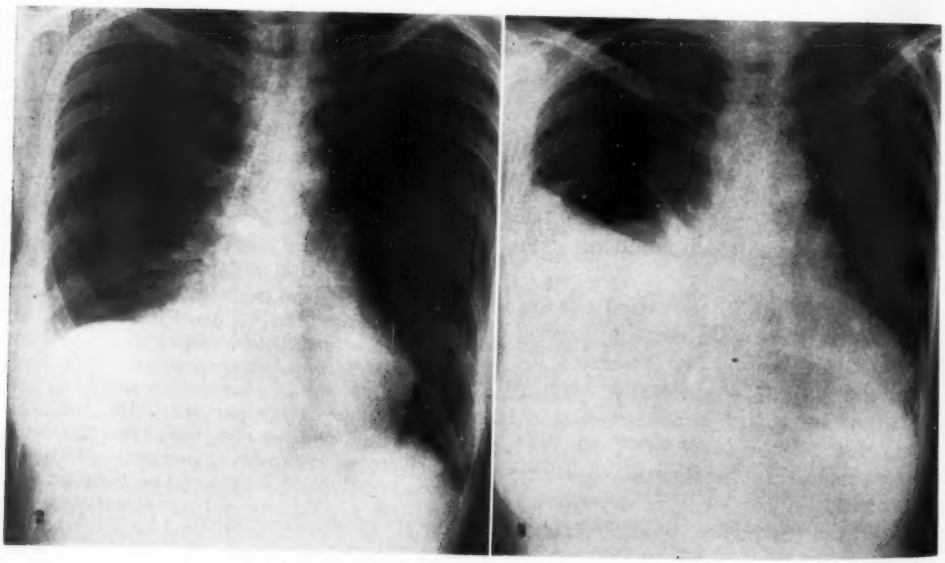

Fig. 2. Right infrapulmonary collection of fluid.

Fig. 3. Increase in right pleural fluid, with extension up the lateral wall and into the interlobar fissures.

dysuria, hematuria, and malaise of a few days duration. She was thin and appeared chronically ill. Her blood pressure was 120/90. The right kidney was larger than normal to palpation; its function was decreased, and there was caliectasis of the right inferior calyx. Blood urea nitrogen was normal. Urine culture was positive for the *Aerobacter-Klebsiella* group.

Aortography was performed under local Xylocaine anesthesia and intravenous Demerol drip on June 13 by the technic of Smith, Rush, and Evans (5). The aorta was not entered on two advancements of the needle, but the third was successful. The aortogram (Fig. 1) demonstrates the needle in the aorta at the level of the interspace between T-11 and T-12. Both leaves of the diaphragm are visualized in normal position. The aortogram was interpreted as normal except for an apparent decrease in arterial circulation in the lower pole of the right kidney, possibly secondary to previous nephrostomy.

The next morning the patient awoke with severe, sharp pains in the back and chest and dyspnea. Physical examination revealed decreased breath sounds at the right base. A chest roentgenogram (Fig. 2) showed a right infrapulmonary collection of fluid with a small amount of air between the fluid and the lung. Right thoracentesis was productive of 1,400 c.c. of milky fluid which contained 15 gm. per cent of total protein and 1.68 gm. per cent of total fat.

A chest roentgenogram (Fig. 3) on the sixth day following aortography revealed an increase in pleural fluid, and its extension up the lateral wall and into the interlobar fissures. Thoracentesis was productive of 1,300 c.c. of chyle.

Thoracentesis was again repeated on the eighth post-aortography day, yielding 700 c.c. of chyle. A closed thoracotomy was then performed, under local anesthesia, through the ninth interspace in the posterior axillary line. With expansion of the lung, the drainage of chyle decreased daily and on the thirteenth post-aortography day the thoracotomy tube was removed. The patient was discharged from the hospital five days later, without pulmonary symptoms and with a negative urine culture.

A chest film on the forty-seventh day after aortography revealed some residual pleural reaction in the right base but was otherwise normal.

COMMENT

Chylothorax is an unusual complication of translumbar aortography. It should be suspected whenever respiratory complications develop following the procedure.

The surgical treatment of chylothorax can consist of any or all of the following: repeated thoracentesis, closed thoracotomy, thoracotomy with ligation of the thoracic duct or its tributaries. Closed thoracotomy has the advantage of simplicity and little discomfort.

SUMMARY

Two previously reported cases of chylothorax following aortography have been reviewed. A third case has been presented which was diagnosed early, treated unsuccessfully by repeated thoracentesis, and then responded well to closed thoracotomy. Difficulty in entering the aorta, necessitating multiple advancements of the needle, was the common factor in these 3 cases. This case is also interesting because of the initial localization of fluid in the infrapulmonary position, which might have caused the initial roentgenogram to be incorrectly interpreted as elevation of the right hemidiaphragm.

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(*Pro le summario in interlingua, vider le pagina 250*)

Renal Papillary Necrosis

Report of a Case[1]

KENNETH J. MAIER, M.D.,[2] EDWIN S. BRADEN, M.D.,[3] and HOWARD C. BURKHEAD, M.D.[3]

NECROTIZING renal papillitis is a severe form of pyelonephritis characterized by a rapid course, infection, and destruction of the renal pyramids by infarct necrosis. This entity, which in the past was diagnosed almost solely at the autopsy table, was first described by von Friedreich (1) in 1877. Occasional accounts appeared in the literature subsequently (2), but it was Günther's report in 1937 which first correlated the appearance with diabetes mellitus (3). Papers by Edmondson *et al.* (2), Robbins *et al.* (4), and Silberstein *et al.* (5) emphasized the importance of being aware of the condition and its clinical recognition. Günther was the first to report the pyelographic changes (6, 7).

Up to April 1955, approximately 283 cases of necrotizing papillitis had been recorded (8). Other reports have since appeared (7, 9–13), but only rarely was the diagnosis made antemortem (6, 8, 10, 14–16) until recently (9, 12, 13), and then chiefly by urography. More rarely the diagnosis has been established by recovery of a sloughed papilla in the urine (2, 4, 7, 14, 17).

The case to follow was diagnosed both histologically, by the recovery of a sloughed renal papilla in the urine, and pyelographically, although the patient did not display the typical clinical symptoms. Several reports have recently appeared citing similar examples (7, 12, 13). These publications have also shown that papillary necrosis is seen in the younger age group and in patients without diabetes or urinary tract obstruction.

CASE REPORT

Mrs. H. N. M., a 52-year-old married white woman, first entered the hospital on July 3, 1958, with right flank and low abdominal pain of three days duration, nausea, vomiting, low-grade fever, mild leukocytosis, hyperglycemia, bacteriuria without glycosuria, and a trace of albumin in the urine. She did not appear acutely or chronically ill. Though she was a known diabetic and had been on insulin since the age of sixteen, she was very unreliable regarding all facets of diabetic regulation. Chest, gastrointestinal, and urographic roentgenograms were normal. The patient improved with antibiotic therapy and insulin adjustment and in three weeks was sent home, where regulation was again haphazard despite instructions.

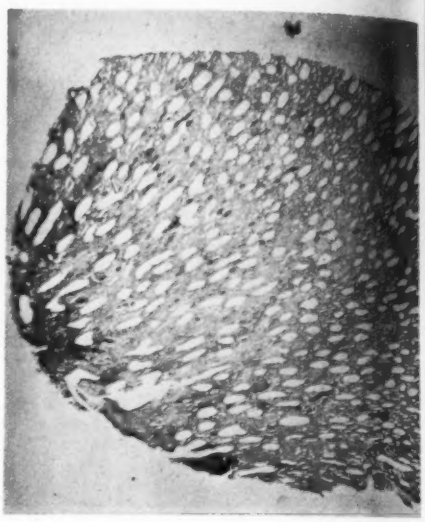

Fig. 1. Photomicrograph of sloughed renal papillary tissue under low power magnification. The specimen was obtained on Sept. 14, 1958.

Second Admission: The patient entered the emergency room on Sept. 14, 1958, with severe colicky pain in the right lower abdomen, radiating to the right groin and thigh, 4+ glycosuria, 1+ albuminuria, and microscopic hematuria and pyuria. Her temperature and white blood count were normal. A few hours later she voided and spontaneously passed a tan tissue nodule, 1.4 × 0.6 × 0.5 cm., with complete relief of symptoms. Histologically this represented a renal papilla (Fig. 1). On comparison with the normal urogram obtained in July (Fig. 2), the urogram of Sept. 15 showed a large defect in the

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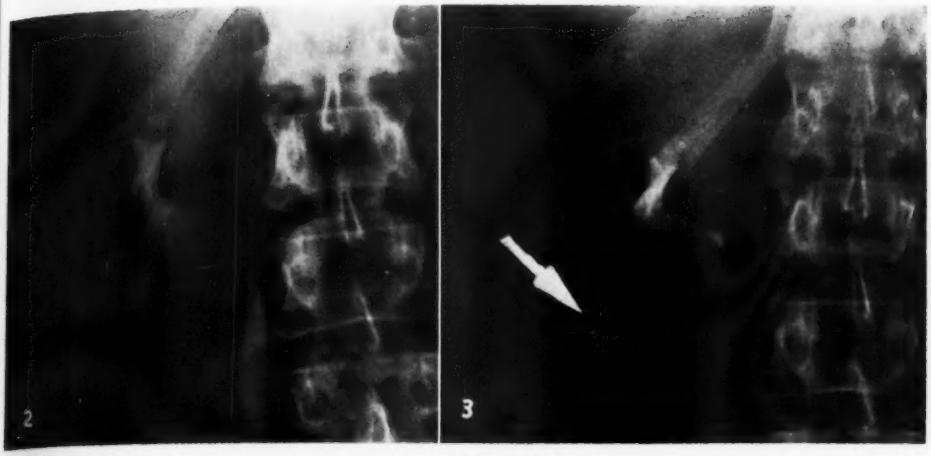

Fig. 2. View of normal right kidney from retrograde pyelogram of July 8, 1938.
Fig. 3. View of right kidney and collecting system on urogram of Sept. 15, 1958, showing origin of papillary slough from lower calyx (arrow).

lower calyx of the right kidney (Fig. 3). This was interpreted as the site of the papillary slough. The hospital course was otherwise uneventful, the temperature and white count continuing normal. The blood urea nitrogen remained slightly elevated. The pyuria responded to antibiotics and the patient was discharged on Sept. 29. She has remained free of urinary symptoms except for a positive urine culture in March 1959, which responded to antibiotics. Apart from two admissions to the hospital for diabetic acidosis in November 1958 and March 1959, the course has been uneventful.

DISCUSSION

In the proved case of papillary necrosis recorded above, none of the clinical findings usually reported in association with this disease was demonstrated. Basically we have a diabetic patient with a urinary tract infection and ureteral colic. Her temperature and white blood count were normal at the time of the slough and, although the passage of the papilla caused extreme discomfort, she did not appear acutely ill or exhibit any of the other findings so often described, such as diabetic coma, septicemia, shock, severe uremia, or oliguria. The case did not end fatally; instead, the patient has recovered fully without any loss in renal function or apparent involvement of the opposite kidney.

The etiology and pathogenesis of papillary necrosis are not clearly understood (3, 5, 7, 9, 10, 13–15, 18), and many theories have been suggested (2–5, 7, 8, 10, 11, 13–15). Currently, the most popular theory attributes the disease to compression of pyramidal blood vessels by inflammatory exudate, particularly in diabetes, and by increased intrapelvic pressure caused by obstruction of the urinary tract (8). Recently, several authors have concluded that there is no pathogenetic connection with diabetes mellitus or urinary tract obstruction (13). Factual evidence remains insufficient for an explanation of the occurrence of this lesion.

SUMMARY

A successfully treated, clinically atypical case of renal papillary necrosis associated with diabetes is presented. The diagnosis was established both by the urographic findings and the recovery of a sloughed renal papilla in the urine.

The etiology and pathogenesis of renal papillary necrosis have not been definitely established.

The most reliable methods of establishing the diagnosis are excretory urography and retrograde pyelography, unless a sloughed papilla is recovered in the urine.

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SUMMARIO IN INTERLINGUA

Necrose Reno-Papillar: Reporto de Un Caso

Es reportate un caso de necrose reno-papillar, associate con diabete. Le patiente exhibiva nulle del symptomas que es typicamente incontrate in iste condition, e le diagnose esseva establite per le retrovation de un sphacelate papilla renal in le urina e le constatation urographic de un grande defecto in le calyce inferior del renal latere dextere le qual representava le sito del sphacelo papillar.

Le etiologia de necrose reno-papillar non es definitemente determinate. Le methodo diagnostic le plus digne de confidentia es urographia excretori o pyelographia retrograde, excepte in le presentia de un sphacelate papilla in le vacuation urinari.

Pneumocystis Carinii Pneumonia[1]

CAROLINE W. ROWE, M.D.[2]

PNEUMOCYSTIS CARINII pneumonia is apparently still rare in the United States, since only seven deaths from this cause have been unequivocally proved. The seventh of these cases, from the John Sealy Hospital, Galveston, Texas, brought to our attention this interesting and serious interstitial plasma-cell pneumonia which we had not heretofore recognized.

Pneumocystis carinii pneumonia has been known in Europe only in recent years, reaching epidemic proportions in the last decade. It was first described by Ammich (2) in 1938. An increasing number of cases were subsequently reported in Germany and Switzerland, with rapid spread peripherally from these countries into other European areas. In 1955, 1 case was reported from England. Three cases were reported from Canada in 1956 and from 1957 to 1959 there have been reported 1 case from Connecticut (3), 2 from Oklahoma (11), 1 from Georgia (8), 1 from Arizona (5), and 1 from Louisiana (10). The first recognized case in the United States was reported in 1955 (9) and *Pneumocystis carinii* may yet present an important problem in this area.

The disease occurs endemically or epidemically within hospital nurseries and seems to have a predilection for premature or debilitated infants, although it has been recorded several times in adult subjects. The organism is described as a parasite of controversial taxonomy, and the mode of transmission is unknown. Antemortem diagnosis is difficult. Treatment is unsatisfactory, and mortality ranges from 15 to 100 per cent.

CLINICAL FEATURES

The onset of interstitial plasma-cell pneumonia is so insidious that it is difficult to determine. The first signs are usually restlessness, languor, and lack of appetite. Tachypnea and a peculiar cyanosis around the mouth and under the eyes suggest respiratory tract involvement. Generalized grayish cyanosis and dyspnea with sternal retraction and prominent flank movements are seen.

Deamer and Zollinger (4) quote Willi as considering the rapid respiratory movement of the lateral abdominal wall the most important clinical finding. Cyanosis may persist even during the administration of oxygen. While cough is not a characteristic feature, it may occur in sudden exhausting attacks. There is usually an inconstant, low-grade fever, or none at all. Rhinitis, diarrhea, and inertia may precede pulmonary involvement by as much as a month.

The discrepancy between the severity of dyspnea and the paucity of physical findings is typical, although fine crepitant rales and bronchial breath sounds may be heard over some lung areas. Clinical studies in various European hospitals have shown that many infants have mild attacks which are detected only by routine counts of the respiratory rate along with frequent chest roentgenograms following exposure to the disease. A respiratory rate exceeding 40 to 50 per minute in the sleeping premature infant is regarded with suspicion. Interstitial emphysema develops progressively. Deamer and Zollinger state that in probably no other disease of infancy is it as frequent, as diffuse, as markedly developed, or as varied in form (mediastinal, perithymic, perivascular, pericardiac, or subcutaneous) as in the late stages of interstitial plasma-cell pneumonia. The duration of the disease is usually four to six weeks.

No satisfactory laboratory method of antemortem diagnosis has been devised. The rapid respiratory rate mentioned above and the rather typical x-ray findings

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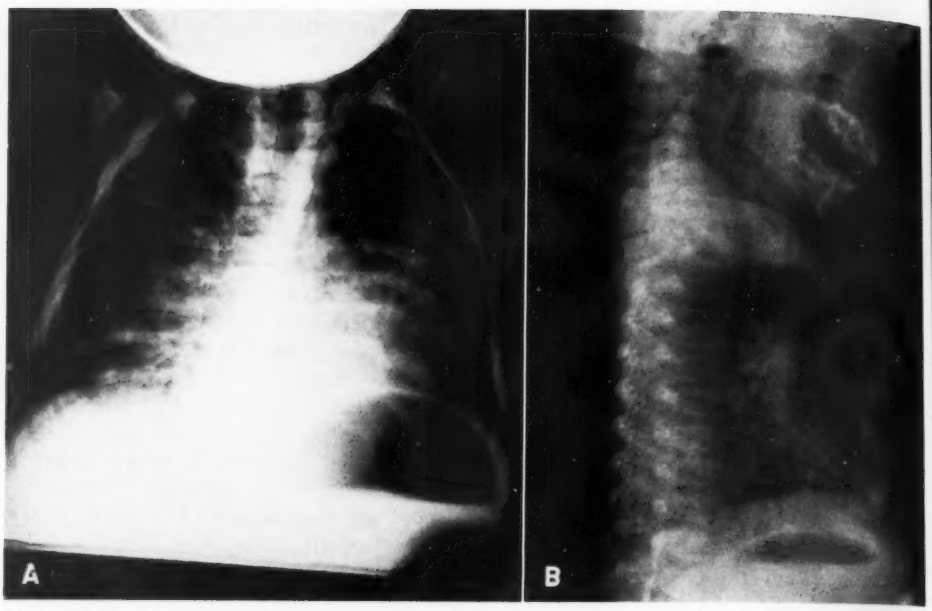

Fig. 1. Admission roentgenograms showing bilateral hazy-to-mottled infiltration, most prominent in the hilar regions.

in suspected cases may prove helpful in making an early diagnosis.

TREATMENT

No consistently effective treatment is available for *Pneumocystis carinii* pneumonia. Almost all known antibiotics have been tried without benefit. Gamma globulin, transfusions of convalescent blood, steroids, and other agents have in general proved of no benefit. Only supportive measures, particularly with oxygen mist, can be offered therapeutically.

CASE REPORT

J. W., a 6-month-old white male infant, was admitted to the John Sealy Hospital on Oct. 1, 1958, following an illness of about two months duration. The onset was insidious, with rapid and labored respiration and episodes of cyanosis about the lips and nail beds. During the second month there had been increasing respiratory distress, occasional diarrhea and vomiting, and progressive weight loss. The child had remained afebrile until one week prior to admission, when a temperature of 39.4° C. developed.

Physical Examination: The infant was dehydrated and malnourished. The nail beds were cyanotic. Except for dyspnea, with respiratory grunting, the chest examination was negative. The liver edge was palpable 3 cm. below the costal margin. No lymph nodes were palpable, nor were any other abnormalities found.

Laboratory Findings: Most of the laboratory tests were noncontributory. The white blood count was 15,300, with 45 per cent polymorphonuclear neutrophilis, 22 per cent small lymphocytes, 21 per cent monocytes, and 4 per cent eosinophils. Nasopharyngeal cultures, blood cultures, spinal fluid specimens, and bone marrow aspirates failed to identify the etiologic agent.

Radiographic Findings: On admission, there was a bilateral infiltration of the lungs, most prominent in the hilar regions, but reaching the periphery in the lower lung fields. The infiltration was hazy-to-mottled in appearance (Fig. 1). Follow-up roentgenograms showed little change, except for gradual extension in the right lung field (Fig. 2), until three weeks later, when pneumomediastinum and subcutaneous emphysema of the neck were evident (Fig. 3).

Hospital Course: Cyanosis and respiratory distress increased and necessitated placing the infant in an oxygen tent on the second hospital day. Tetracycline was given. Supplemental intravenous feedings and plasma infusions were instituted because of the weight loss and dehydration. Two weeks following admission, the patient was digitalized because of suspected congestive heart failure. Over the following few days, his condition improved; he became more alert, his breathing was less labored, he could be kept out of the oxygen

tent for longer intervals and he was again able to take oral feedings. On Oct. 30, however, he exhibited a sudden increase in respiratory distress, was found in shock, and died despite emergency measures.

Autopsy Findings: The lungs did not collapse when the chest was opened; numerous gas-containing blebs were seen in the mediastinum. Throughout the lungs, which were noncrepitant and heavy, were multiple, irregular, firm, light-gray nodules, ranging in size from 1 to 5 mm., replacing 50 per cent of the parenchyma.

Emphysema, thickening of the alveolar walls, and focal areas of hemorrhage were noted. Many alveoli were completely filled with a foamy, pink-staining material having the appearance of a honeycomb. Under oil immersion, round, pink, light-refracting bodies could be seen in not a few of these "honeycombs." The cysts were best demonstrated with Gömbri silver stains. In alveoli which were not completely filled with *Pneumocystis carinii*, there were collections of histiocytes, lymphocytes, and plasma cells. A great number of the histiocytes appeared to have ingested the *Pneumocystis* organism. Many sections showed calcification in the alveolar and bronchiolar walls. In addition, numerous aggregates of *Pneumocystis carinii* showed beginning calcification.

Outside the lungs, there were calcifications in the kidneys, predominantly in the collecting systems, but also in the distal convoluted tubules. Lymph nodes were markedly reduced.

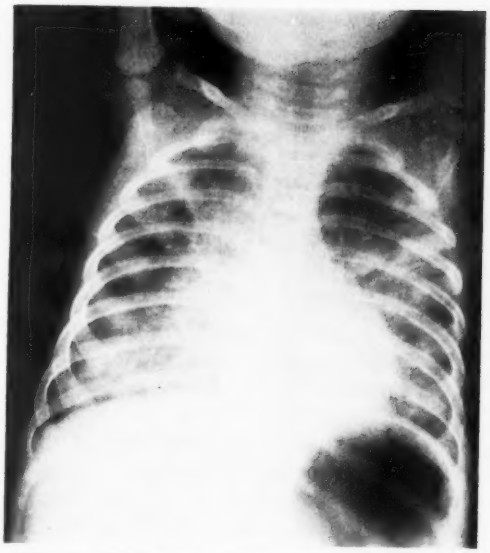

Fig. 2. Follow-up roentgenogram demonstrating extension of the infiltration toward the periphery of the lung fields.

Fig. 3. Pneumomediastinum and subcutaneous emphysema, evident on roentgenograms obtained three weeks after hospital admission.

COMMENT

Pneumocystis carinii was not identified antemortem, but had been considered. The typical intra-alveolar pulmonary exudate found at autopsy was consistent with this impression. The diagnosis was confirmed by Dr. H. Hamperl of the Institute of Pathology at Bonn University, Germany.

DISCUSSION OF RADIOGRAPHIC FINDINGS

In the published reports, both European and American, the radiographic findings have been so consistent that, although they cannot be regarded as highly pathognomonic of this entity, they should bring *Pneumocystis carinii* pneumonia to mind as a possible diagnosis. According to Gerrard (7), the x-ray findings together with the clinical picture are sufficient to make the diagnosis, although confirmation may not be possible unless the infant dies. A characteristic infiltrating consolidation which spreads peripherally from the hilus, is associated with a rapid respiratory rate and a white blood count which may be as high as 20,000 to 40,000, with 70 per cent neutrophils. An eosinophilia of 10 to 15 per cent is not unusual. For some time, the consolidation abut the hilus is hazy to patchy in nature, and the relative sparing of the periphery of the lung fields may be quite striking. The infiltrate is not lobar, and pleural reaction and hilar adenopathy are usually not a feature of the radiographic findings.

Ahvenainen's (1) description of the early radiographic findings includes hilar densities and spot-like shadows in both lung fields which grow and become more confluent. These may be so severe that no air is seen. Interstitial and mediastinal emphysema may occur. The radiographic findings may be pronounced even though the clinical signs are light.

Sternberg and Rosenthal (12) point out the uniformity in the nature and distribution of the infiltrations. Confluent, hazy opacities spreading from the hili to the periphery are characteristic. The most severe involvement may be seen when the child is improving clinically. Clearing could be demonstrated within three weeks to three months.

Deamer and Zollinger (4) pointed out that early cases may be discovered by roentgenography after known exposure to the disease. Gajdusek (6) followed mild cases with little clinical evidence of the disease by means of radiographs and emphasized that evidence of pulmonary infiltration can regularly be found very early, even when the pneumonia is clinically unapparent. A diffuse, ground-glass cloudiness, with lighter areas produced by emphysema, is the usual picture and is often seen one week before the onset of symptoms. Gajdusek considered infants with a respiratory rate of 40 to 50 per minute, who had been exposed to the disease, suspect, and roentgenograms were subsequently obtained in such cases.

SUMMARY

Pneumocystis carinii pneumonia is difficult to diagnose antemortem, but roentgen findings are consistent and helpful in making a presumptive diagnosis. They may precede clinical signs and symptoms and infants who have been exposed to the disease should be followed radiographically, especially if the respiratory rate is rapid. Pulmonary infiltration appears hazy to mottled, extending out from the hilar region in a fan-like distribution which may lead to confusion with pulmonary edema. The process may spread eventually to the periphery so that no air space can be seen on the films. Interstitial emphysema is frequently diffuse, markedly developed, and varied in form.

A new case is reported.

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SUMMARIO IN INTERLINGUA

Pneumonia per Pneumocystis carinii

Es reportate un caso de pneumonia per *Pneumocystis carinii* in un infante de sex menses de etate. Es opinate que isto es le septime tal caso con exito mortal reportate in le litteratura statounitese, ben que in Europa le morbo es epidemic.

Le constatationes roentgenologic non es pathognomonic, sed illos es uniforme e utile in le establimento de un diagnose presumptive. Il occurre que illos precede omne manifestation clinic, e infantes qui ha essite exponite a iste morbo debe esser tenite sub observation radiographic, specialmente si lor frequentia respiratori es accelerate. Le infiltrationes pulmonar ha un apparentia nebulose o marmorate. Illos se expande ab le region hilar e attinge a vices in le curso del tempore le peripheria de maniera que nulle spatio de aere remane visibile. Emphysema interstitial es frequentemente diffuse, marcatemente disveloppate, e variate in su forma. Nulle uniformemente efficace therapia es disponibile.

Standardization of Physical Factors in Radiographic Exposures[1]

HYMAN L. GILDENHORN, M.D.,[2] I. REHMAN, Ph.D.,[3] L. PAPE, M.S.,[4] and S. BAKER, R.T.[5]

THE NEED for more accurate dosimetry and calibration of x-ray equipment is readily apparent with the increasing interest in the application of cineradiography. We have attempted to determine the conditions which would yield the greatest film blackening (density) with the minimum radiation exposure to the patient.

The effort to provide the greatest amount of radiographic information with minimum exposure to the patient has received much attention recently. Many studies have reported detailed measurements made with patients, phantoms, or both (1–4). In the field of cineradiography, however, reported radiation doses are not easily interpreted, since the data are often incomplete in one or another physical parameter (5). As a result, the duplication of factors and comparison of independent observations are difficult. It is necessary, therefore, to determine the physical factors involved in several of the available systems of cineradiography in terms of exposure dose rate and film-blackening effects.

In attempting to set up a control study with the goal of determining dose levels for varying sets of physical factors, we became aware of marked discrepancies in the exposure dose rate of recently installed and calibrated radiographic units. The exposure was measured by densitometry and by ionization chambers. The values obtained in a preliminary study on one of these units varied widely from those anticipated. Film blackening increased with increasing voltage up to 120 kv. Above this level the anticipated blackening did not occur. Instead, the density decreased. As a corollary, the relationship of exposure dose rate with milliamperage was investigated. The anticipated increase of dose rate as a result of increasing milliamperage was not obtained. These inconsistencies in factors commonly assumed to be accurate prompted us to make a more detailed study of the physical factors involved in radiographic technics.

A check on the efficiency of our coning devices revealed unexpected leakage of direct radiation through the tube housings and beam-limiting devices. The implication for radiation protection is obvious. We were particularly concerned with elimination of this leakage radiation as a possible contributor to film blackening.

Figure 1A shows patterns of excessive leakage through different beam limiting devices. Figure 1B shows the pattern of film blackening before and after additional lead shielding was placed around our tube housings.

On installation, the radiographic units were calibrated by standard technics. These included a visual penetrometer test (step wedge), use of spinning top to check the timer, and milliampere-second correlation. The equipment was then turned over to the radiology department as calibrated and ready for operation. Inability to duplicate the expected film blackening on all settings led to re-calibration of the equipment. Information concerning the discrepancies noted in the course of our work may be of general interest. Subsequent reports will deal with data concerning the comparative radiation doses and film blackening in the direct cineradiographic technic as compared with image intensification with various commercially

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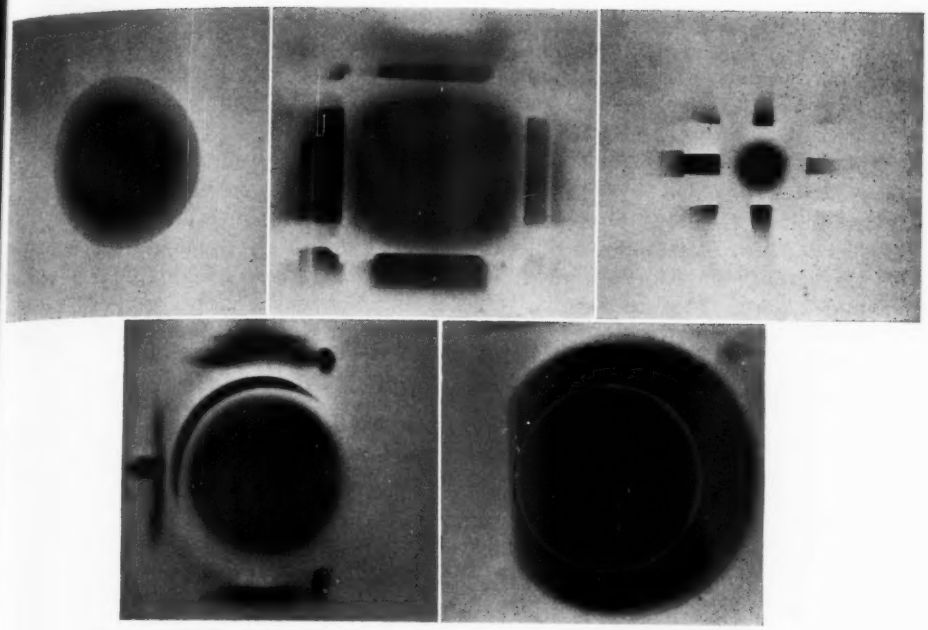

Fig. 1A. Patterns of excessive leakage through different beam-limiting devices.

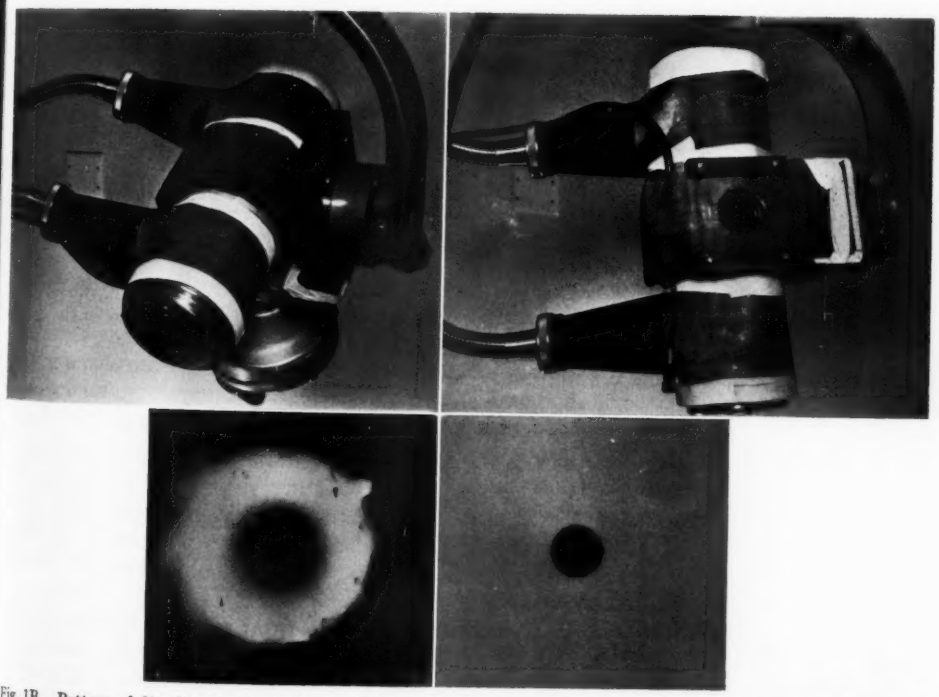

Fig. 1B. Pattern of film blackening before and after additional lead shielding was placed around tube housings

available intensifiers. In addition, a technic for cross-calibration of radiographic units utilizing half-value layer determinations will be presented.

DENSITY MEASUREMENTS

The study was carried out with the radiographic units of three different manufacturers. All utilized 500-ma generators with Dynamax 40 rotating anode, 1.0 mm. and 2.0 mm. focal-spot x-ray tubes. Each 500-ma generator was supplied by its own 25-kv-ampere power supply to minimize fluctuation in line voltage.

An 8 × 10 cassette with Radelin "T" general purpose intensifying screens and Kodak Blue Brand Medical x-ray film was placed on the x-ray table top. The cassette was divided into equal sections, and multiple exposures were made while the remainder of the cassette was covered with lead. Each exposure was repeated at least four times to average out fluctuation in tube output.

All exposures were made at 46 inches target-film distance. Each series of films, representing a particular calibration study, was then developed at the same time. The films were read on an Ansco-Macbeth densitometer. All dosage measurements were made with a Landsverk 200-mr dosimeter. The Landsverk chamber was calibrated by the Landsverk Company at the low-energy ranges and calibrated against a Victoreen "r" chamber at the intermediate ranges. Figure 2 is a plot of chamber sensitivity vs. kev. All roentgen measurements were corrected with values taken from this graph.

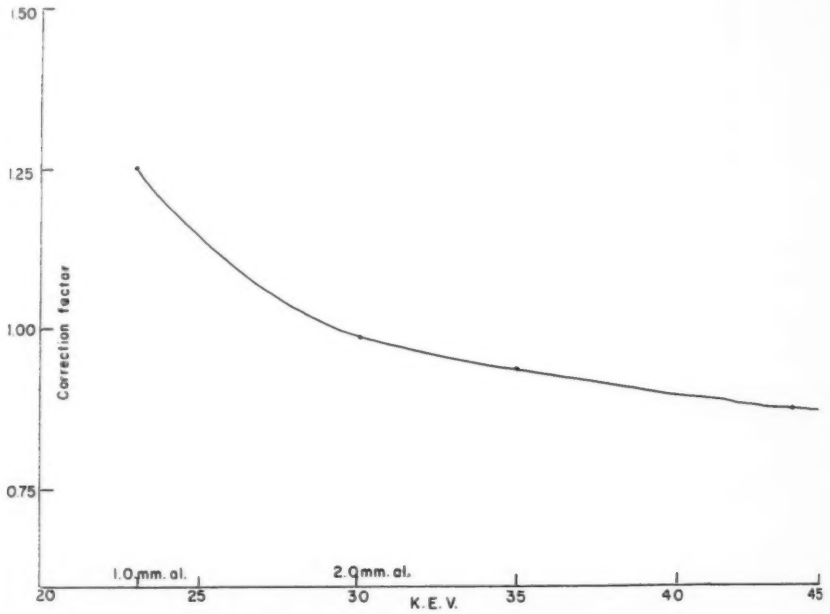

Fig. 2. Correction factors for Landsverk 200 mr dosimeter.

PROBLEMS ENCOUNTERED IN MEASUREMENTS

The constancy of a number of parameters was investigated. These included: (1) timer accuracy, (2) intensifying screen response, (3) film processing, (4) kilovoltage, (5) milliamperage, and (6) filtration factors. Since each of these factors affects exposure dose rate and/or film blackening, a detailed study was undertaken to standardize as many of them as possible.

1. *Timer Accuracy:* Two aspects of timer accuracy need to be considered: (1) interval consistency and (2) absolute timer accuracy.

The interval consistency was investigated by measuring exposure dose rate for various timer settings (see, for example, Fig. 3). The study demonstrated significant discrepancies and, in order to verify the data, a series of spinning top measurements were made for timer settings of 1/120 second to 1 second.

In view of this situation, any particular series of exposures in which time was to be held constant was made with a short timer setting.

2. *Intensifying Screen Response:* The possibility that variations in film blackening for constant kvp and ma settings might be due to differences in cassette intensifier screen responses led to a further study and evaluation of the cassette screen output.

Our studies on cassette intensifier screens

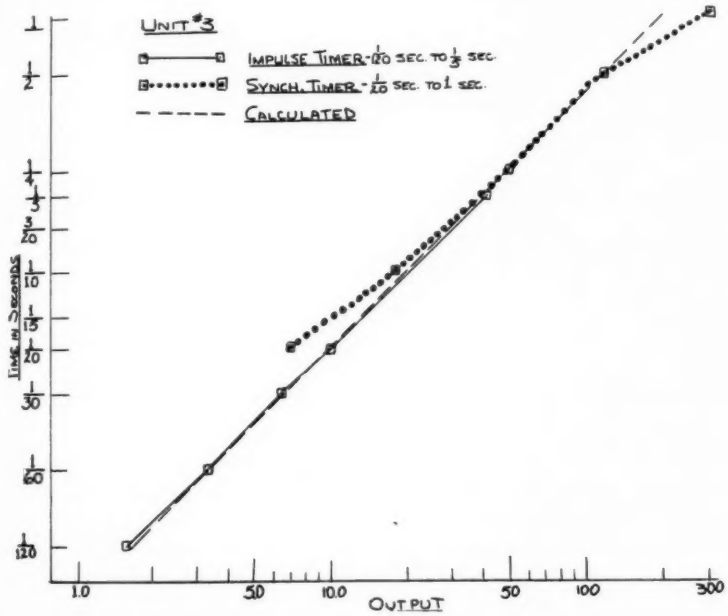

Fig. 3. Exposure dose rate (mr) vs. time for x-ray unit.

It is apparent that there is generally good absolute timer accuracy and interval consistency for timer settings of 1/120 second to 1/10 second. For longer interval settings there are marked deviations. For example, the 1/2-second timer interval setting on the synchronous timer in Figure 3 represents an actual exposure interval of 0.484 second, while the 1-second setting represents an exposure of 1.4 seconds. Thus it appears that the original timer calibration was made for short timer settings and the accuracy extrapolated to the longer timer settings.

showed a variation in film-b lackening effec from one set of screens to another, although the screens were purchased at the same time. In addition, the data seem to indicate a slight decay of the fluorescing properties of the screens with time.

The screens tested were manufactured by two different producers and in general their intensification effects with age were similar.

To eliminate the factor of slight variation in intensification noted from one set of screens to another, a single cassette was used in the calibration studies. These

small fluctuations are important because the factors may be selected so that the errors are additive, resulting in a large total error.

3. *Film Processing:* All of the films were developed in an automatic processor. Although the development factors, such as temperature, solution strength, and processing time were held relatively constant, some variations in density were noted from day to day (Fig. 4). A correction factor was employed to compensate for these variations due to film processing.

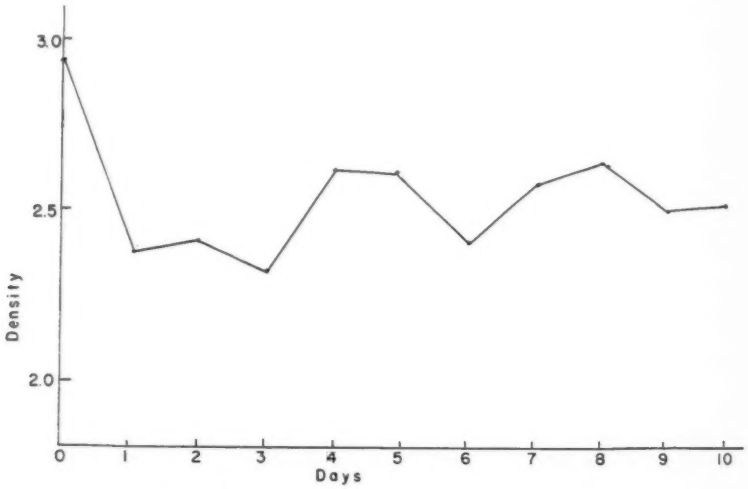

Fig. 4. Daily fluctuations in film density due to processing.

4. *Kilovoltage:* An increase in exposure dose rate is expected with increase in kilovoltage. This was noted up to 120 kv, but above this level a decrease in exposure dose rate was found at 130 kv. Half-value layer studies were carried out, since a spark-gap evaluation was not available. This provided an alternate method of determining effective kilovoltage range. The half-value layer determinations at 120- and 130-kv settings were found to be nearly identical, thus indicating that a 10-kv increment was not obtained. Subsequent inquiry brought out the fact that an upper limit of 120 kv was pre-set at installation regardless of control panel setting.

5. *Milliamperage:* It was found that there was considerable variation from the expected multiplication of exposure dose rate with change in milliamperage stations when time and kilovoltage were held constant (6). A check of one of the units by the manufacturer showed that the 25-ma station produced a tube current of 31 ma and the 50-ma station produced a tube current of 42 ma. These measurements are consistent with the outputs we found, namely, 0.56 r/sec. at 25 ma and 0.80 r/sec. at 50 ma.

6. *Filtration Factors:* The measured half-value layers with added filtration did not correspond to the expected levels, but were considerably higher. While half-value layer determinations with inherent filtration at 120 kv corresponded to those reported in the literature (6), the addition of 3 mm. aluminum filters supplied by the manufacturers gave a half-value layer in the order of 7 mm. aluminum. Independent determination on a 250-kv therapy unit set for 120 kv with a known 3 mm. aluminum filter gave a half-value layer of approximately 5 mm. aluminum. Investigation of the filters used on the diagnostic units showed them to be an aluminum alloy with a greater coefficient of

absorption than pure aluminum filters. Replacement of the alloy with known 3-mm. aluminum filters decreased the half-value layer to the anticipated range.

CONCLUSIONS

Many factors are taken for granted in the use of routine radiographic installations. A check of three such installations revealed the following undesirable conditions:

1. Inefficient shielding of the tube housing and coning devices.
2. Timer inaccuracies.
3. Variation in intensifying screen response.
4. Fluctuations in film density resulting from processing technic.
5. Impure aluminum filters, providing more heavily filtered beams than anticipated.
6. Quality and exposure dose rate inconsistent with the kv and ma stations.

In order to compare different radiographic systems properly, one must be aware of the above conditions and should take steps to eliminate or correct them.

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SUMMARIO IN INTERLINGUA

Standardisation de Factores Physic in Expositiones Radiographic

In le uso del installationes radiographic routinari, multe factores es generalmente reguardate como non-problematic e non requirente ulle attention special. Un visita de tres tal installationes revelava le sequente indesirabile conditiones: (1) Inefficacia del armatura in le montage del tubo e in le dispositivos de conation; (2) inaccuratias del dispositivo chronometric; (3) variabilitate del responsa del ecran de intensification; (4) fluctuationes in le densitate del pelliculas, resultante ab factores technic del processage; (5) filtros de aluminio impur, effectuante un plus forte filtration del fasce que lo que esseva planate; e (6) non-congruentia del qualitate e dosage de exposition con le postos de kv e ma.

Pro comparar differente systemas radiographic appropriatemente, on debe prestar attention al supra-mentionate conditiones e effortiar se a eliminar o corriger los.

The Effectiveness of Oral Cholecystagogues and Intravenous Cholecystokinin in Producing Bile Duct Visualization During Oral Cholecystography[1]

HOWARD H. FEIGELSON, M.D., I. EDWARD BERK, M.D., MYRON H. JOYRICH, M.D., RAYMOND A. GAGLIARDI, M.D., and ARTHUR S. SHUFRO, M.D.

RADIOGRAPHIC examination of the extrahepatic biliary ducts by stimulation of the opacified gallbladder to evacuate its contents has received increasing attention as an integral part of oral cholecystography (1, 3, 8, 11, 13–16). The introduction of improved contrast media did much to create interest in the procedure due to the greater frequency with which the extrahepatic ductal system could be visualized (5, 7, 12). We have elected to study the effectiveness of various orally administered cholecystagogues in producing visualization of the bile ducts when the gallbladder has been opacified following the administration of iopanoic acid (Telepaque) by mouth. Our observations suggest that most normal ducts can be visualized in this way. It was not our object at this time to evaluate the abnormalities thus demonstrated. A group of patients were similarly studied after the intravenous administration of cholecystokinin[2] (10).

We wish in this report to consider only the relative usefulness of these several agents in bringing about visualization of the ducts by a simple (single film) examination adaptable to routine use. The findings in the ducts and the diagnostic information obtained by ductal visualization will form the subject of a separate communication.

MATERIALS AND METHODS

A total of 2,904 patients were studied. Each had been given Telepaque in doses ranging from 1.5 to 6.0 gm. fourteen hours before the radiographic examination, with satisfactory opacification of the gallbladder for diagnostic evaluation. Of this group, 2,855 were given an oral cholecystagogue and 49 were given cholecystokinin intravenously. The oral cholecystagogues and the doses are shown in Table I. The cholecystokinin was administered intravenously over a two-minute period in a dose of 3.0 mg. dissolved in 20 c.c. of saline.

TABLE I: VISUALIZATION FOLLOWING ADMINISTRATION OF 5 ORAL CHOLECYSTAGOGUES AND INTRAVENOUS CHOLECYSTOKININ

Preparation and Amount	No. of Cases	No. with Visualization of Ducts
Cholex* (30 c.c.)	2,619	1,503 (57.4%)
GB Prep† (60 c.c.)	67	53 (79.4%)
Gall Prep S ‡ (60 c.c.)	21	15 (71.4%)
Saff§ (60 c.c.)	46	33 (71.7%)
Ediol‖ (60 c.c.)	102	62 (60.8%)
Cholecystokinin	49	40 (81.7%)

* Fresh egg yolk, soya lecithin, glycerin, and peanut oil (Bell-Craig, Inc.)

† Fifty per cent (W/V) aqueous emulsion of refined corn oil (Gray Pharmaceutical Co.)

‡ Thirty-three and one-third per cent (W/V) aqueous solution of D-Sorbitol (Gray Pharmaceutical Co.)

§ Aqueous emulsion of safflower oil (Abbott Laboratories).

‖ Vegetable oil 50 per cent, sucrose U.S.P. 12.5 per cent (SchenLabs Pharmaceuticals, Inc.)

Multiple serial films were taken at various intervals after the administration of the cholecystagogue (2, 6). On the basis of these, the time interval at which the bile ducts appeared to be most consistently visualized was selected to be adopted for a single post-evacuation film in subsequent cases. This period proved to be twenty minutes for the oral cholecystagogues. This differs somewhat from the optimum post-meal time specified by others, but the difference is not great. Shehadi (15), for example, found that biliary duct visualization was best obtained in from ten to fifteen minutes after oral administration of the fat meal, and Ber-

[1] From the Departments of Radiology and Medicine, Sinai Hospital of Detroit and Wayne State University College of Medicine, Detroit, Mich. Accepted for publication in November 1959.

[2] Sq 9662 Pancreozymin-cholecystokinin kindly supplied for investigation by E. R. Squibb & Sons.

covitz *et al.* (1) reported ductal visualization to be most satisfactory at thirty minutes after the fat meal. The time interval that seemed most suitable for visualization of the extrahepatic ducts after the intravenous injection of cholecystokinin was eight minutes (2), although Jorpes and Mutt (10) have demonstrated that maximum gallbladder contraction occurs from ten to twenty minutes after injection of this preparation. When oral cholecystagogues were used, a fat meal was given upon completion of the usual examination, and twenty minutes later a single film was obtained in the right posterior oblique position. No paregoric, morphine, or Demerol was administered to enhance ductal visualization. Limiting the examination to one film kept the procedure simple.

REACTIONS

No major reactions occurred in the 49 patients given cholecystokinin. Twelve complained of epigastric pain coming on two or three minutes after completion of injection, but this usually subsided within five minutes. Transient flushing of a minor degree was observed in 29. There were no skin reactions or other allergic manifestations.

Cholex, GB Prep, Gall Prep S, Saff, and Ediol were equally palatable to the patients. No untoward reactions were produced by any of these materials, though at least 3 patients who received Ediol had an uncontrollable urge to defecate about ninety minutes later.

RESULTS

As shown by the tabulation of results (Table I), successful visualization of the common bile duct followed administration of Cholex in 57.4 per cent of cases; of GB Prep in 79.4 per cent; of Gall Prep S in 71.4 per cent; of Saff in 71.7 per cent; of Ediol in 60.8 per cent; of cholecystokinin in 81.7 per cent. It is significant that this relatively high incidence of duct visualization was achieved despite the use in the great majority of these cases of a single right posterior oblique post-evacuation film.

DISCUSSION

We have tried to include evaluation of the biliary ducts as an integral part of our oral cholecystographic studies. We have felt that it was possible, with a single extra film, to determine the size of the ducts, the absence or presence of calculi within them, and their displacement by masses. In addition to visualization of the ducts, there is afforded a further view of the gallbladder following contraction. This has been known to reveal calculi that were obscured when the gallbladder was full. We have found it possible in some cases, as have others (Twiss *et al.*, 17), to opacify both the common hepatic and the common bile ducts in the absence of gallbladder visualization, when the cystic duct was obstructed. Nevertheless, we have had our greatest success in demonstrating the ductal system during oral cholecystography with the use of fatty meals to evacuate opacified gallbladders.

The fatty meal originated as a method of evaluating the ability of the gallbladder to empty. With increasing experience, however, it became generally accepted that little information of clinical significance was obtained by this method and in consequence the post-evacuation study was largely abandoned. Its re-institution, however, may be considered, not primarily to demonstrate gallbladder emptying, but to allow simultaneous study of the cystic and common bile ducts.

In our hands, varying degrees of duct visualization have been obtained with the cholecystagogues tested. Intravenous cholecystokinin enjoys a slight superiority in terms of frequency of visualization and also requires less time. In a busy radiology department this time element may be of considerable importance. An additional advantage is the fact that other radiographic studies requiring fasting by the patient may be scheduled at the same time. The oral cholecystagogues, on the

other hand, have the advantage of being relatively innocuous and of not requiring the added effort of intravenous administration.

CONCLUSIONS

1. A variety of orally administered cholecystagogues currently in use (Cholex, GB Prop, Gall Prep S, Ediol, and Saff) have been shown to produce satisfactory and frequent visualization of the common bile duct when administered to patients in whom the gallbladder has been adequately opacified by an ingested contrast medium.

2. The common bile duct was most consistently visualized twenty minutes after the oral administration of the cholecystagogue. A single film taken at this time may serve satisfactorily for routine purposes.

3. Cholecystokinin administered intravenously resulted in visualization of the common bile duct in a slightly higher percentage of cases. No major complications were noted in the 49 patients to whom this preparation was given.

4. Cholecystokinin produced visualization of the common bile duct as early as one minute following injection, although optimum visualization in most cases was obtained after eight minutes.

5. Oral cholecystography should be viewed as a procedure designed to visualize not only the gallbladder but also the cystic and common bile ducts.

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SUMMARIO IN INTERLINGUA

Le Efficacia de Cholecystagogos per Via Oral e de Cholecystokinina per Via Intravenose in Producer Visualisation del Ducto Biliari Durante Cholecystographia Oral

Le autores ha studiate le efficacia de oral cholecystagogos e de intravenose cholecystokinina in producer visualisation del ducto biliari quando le vesica biliari es opacificate per Telepaque. Un total de 2.904 patientes esseva studiate. Cinque cholecystagogos oral esseva empleate, con variationes in le procentage del visualisationes de ducto biliari ab 57,4 ad 79,4. Quando cholecystokinina esseva adminis-

trate, le procentage del demonstration ductal esseva 81,7. Esseva constatate que un sol pellicula post le evacuation sufficeva, providite que illo esseva exponite quando le visualisation esseva le plus uniforme, i.e. vinti minutas post le administration del cholecystagogos oral e octo minutas post le administration de cholecystokinina.

Nulle major reactiones occurreva le patientes de iste serie. Dece-duo del 49 patientes qui recipeva cholecystokinina se plangeva de transiente dolores epigastric e 29 de transiente rubor. Occurreva nulle manifestationes allergic.

Le autores conclude que cholecystographia oral deberea esser reguardate como un methodo pro le visualisation non solmente del vesica biliari sed etiam del ductos cystic e biliari commun.

Angiotomography: A Preliminary Report

GROVER J. LIESE, M.D.

ANGIOTOMOGRAPHY is a term coined to denote the use of body-section radiography in conjunction with arteriography. It has been used initially to augment visualization of portions of the abdominal aorta and its branches, made radiopaque by the intravenous injection of contrast material.

TECHNIC

Arterial Opacification: The method of intravenous opacification follows closely the technic described by Steinberg *et al.* Number 12 Robb-Steinberg needles are placed either percutaneously or by cutdown in antecubital veins bilaterally. After an arm-to-tongue circulation time has been determined with Decholin, a bolus of warmed contrast material (Hypaque 85 per cent) is injected rapidly into each arm. The total dosage is 100 c.c. divided equally between two 50-c.c. syringes. Opacification of the abdominal aorta will be optimal at a time one to two seconds greater than the measured circulation time. Perfusion of abdominal organs takes place immediately subsequent to that event.

TOMOGRAPHY

Cassette: With a Siemens multisection 10 × 12-inch cassette permitting 7 simultaneous exposures at various levels preliminary films are made at 1-cm. intervals, 7 to 13 cm. from the table-top for the average patient. This range will extend from approximately the midportion of the kidney to a point 1 to 3 cm. anterior to the anterior margin of the vertebral column. The films are centered on the second lumbar vertebra. Anatomically, the aorta is situated immediately anterior and slightly lateral to the vertebral bodies. Adjustments in positioning and technic are made on the basis of the preliminary films. In the multisection cassette, films may be placed at varying intervals of 0.5, 1, or 1.5 cm. over a total distance of 9 cm., as desired. The region of the aorta is bracketed at 0.5-cm. intervals.

Roentgen Factors: With a Siemens Universal Planigraph with a 50-inch tube-to-film distance, physical factors have been: three and one-half seconds, 100 ma, and 105 kv, or two and a half seconds, 200 ma, and 105 kv. It has been observed that rather marked absorption of x-rays takes place while contrast material is perfusing the liver, spleen, kidneys, and vessels. Consequently, an excellent technic as judged by preliminary films will be insufficient in the presence of injected contrast material. Adequate penetration has been found to be essential for optimal visualization. The use of high-speed film has afforded increased contrast in more obese patients.

Timing: The exposure is begun after an interval precisely one second longer than the circulation time and usually continued for three and a half seconds. During this time there is rapid perfusion of the kidneys, spleen, and liver, as well as vascular filling. Therefore, an excellent nephrogram effect is obtained.

RESULTS

Since the origins of the renal arteries are largely obscured by the underlying vertebral column in the anteroposterior film during conventional intravenous arteriography, angiotomography has been particularly helpful in visualizing this area. In addition, the following other branches of the aorta have been readily identifiable: the celiac axis, superior mesenteric artery and its omental branches, inferior mesenteric artery, splenic artery, some of the gastric branches of that vessel, the hepatic

[1] From the Department of Radiology, Stanford University School of Medicine, Palo Alto, Calif. Submitted for publication in March 1960.

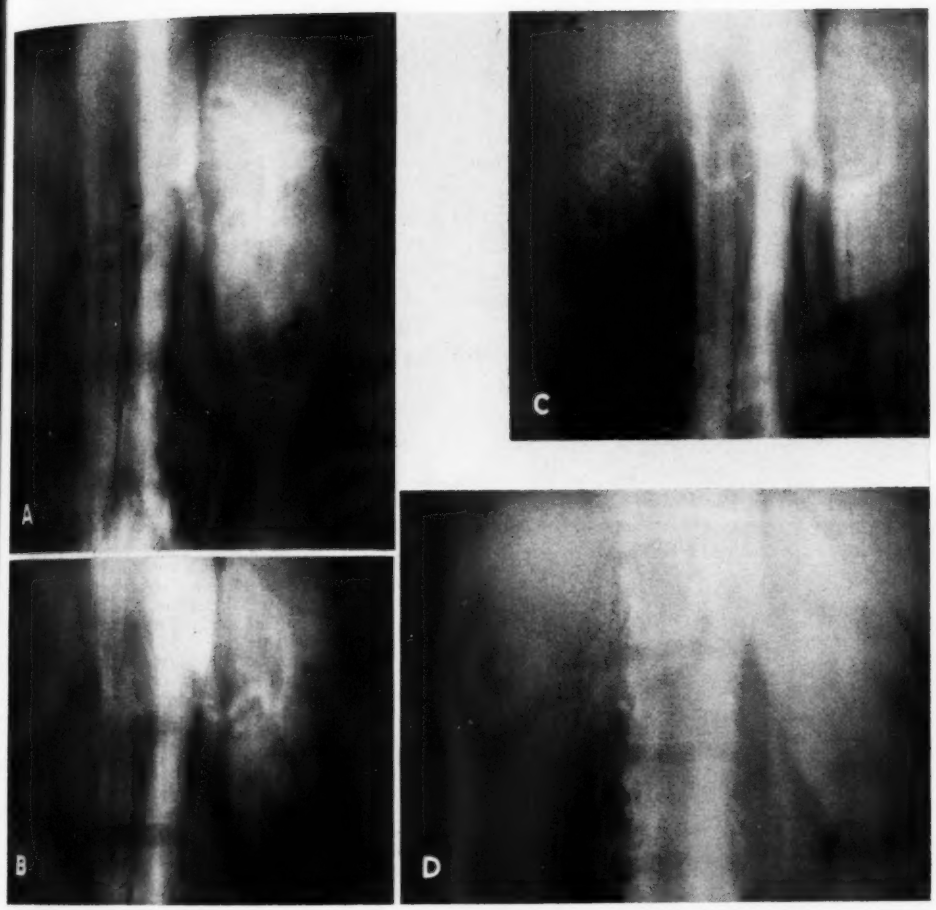

Fig. 1. A. Section at 12 cm. from the table-top, demonstrating the diminished caliber of the right renal artery at its origin. In addition, the aorta is narrowed, with associated calcific plaques. The superior mesenteric artery and branches, as well as a part of the splenic artery, are seen.

B. At 11 cm., the left renal artery has become visible and branches of the right renal artery are more apparent.

C. At 14 cm., the origin of the splenic artery is well seen, as is the superior mesenteric artery. The hepatic artery and one of its branches, the gastroduodenal artery, are seen.

D. At 9.5 cm., the renal parenchyma is visualized. The difference in nephrogram effect is readily apparent, with reduced blood flow demonstrated on the right. The aorta is blurred and several lumbar arteries are seen adjacent to the vertebral bodies.

artery, and the gastroduodenal artery. Abnormalities of the abdominal aortic lumen are remarkably well seen.

DISCUSSION

The combination of intravenous arteriography and tomography permits clear delineation of the abdominal aorta and its branches, obviating the need for direct filling of the aorta by catheter or the translumbar route in most instances. The method should find early application in the investigation of hypertensive patients, particularly those in the younger age groups or with sudden onset, since anatomical abnormalities of the renal vessels are well documented and disparity in the early nephrogram effect in the two kidneys provides clear evidence of unilateral renal ischemia, which is a reflection of renal vascular capacity rather than of tubular excretion.

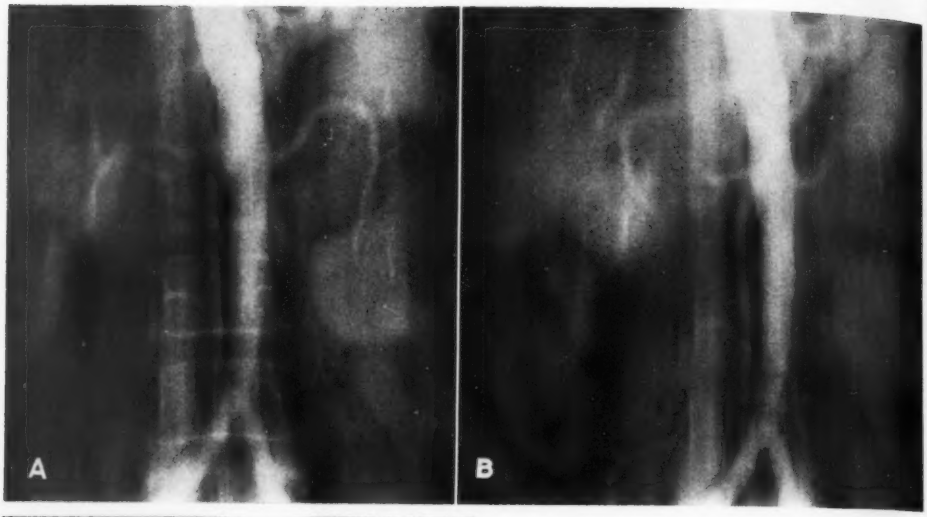

Fig. 2. A. At 11 cm., the left renal artery and the distal branching right renal artery are visualized.
B. At 12 cm., the proximal right renal artery is demonstrated. The aorta is narrowed in its lower portion. Perfusion of contrast material into the small intestinal wall is also apparent.
C. At 13 cm., the renal arteries have been blurred out. There is excellent visualization of the region of the celiac axis, the origin and proximal course of the splenic artery, and the hepatic artery. The gastroduodenal branch and sub-branches, the right gastro-epiploic and superior pancreaticoduodenal are again demonstrated. The superior mesenteric is seen descending to the right of the aorta. The inferior mesenteric originates a few centimeters above the bifurcation and runs parallel to and to the left of the aorta.

It would also seem advisable to utilize tomography during the aortogram phase of nephrotomography for more adequate demonstration of either normal or abnormal vessels supplying a renal neoplasm, with injection of 70 to 75 c.c. in the average patient. Other portions of the circulatory system should lend themselves to roentgen demonstration as readily as the abdominal aorta and its main branches. In short, it seems probable that almost any normal or abnormal collection of vessels should be well delineated by the accurate use of tomography at the time contrast material fills such vessels. Tomography combined with selective arterial introduction of an opaque medium should clearly outline peripheral branches of the injected vessels.

In slender patients it is apparent that a significant reduction of the dose of contrast material below 100 c.c. is possible. Also, the rapidity of injection under these circumstances is slightly less critical for an adequately informative examination.

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SUMMARIO IN INTERLINGUA

Angiotomographia

Angiotomographia, i.e. le uso de radiographia de sectiones del corpore in conjunction con arteriographia, ha essite empleate pro augmentar le visualisation de portiones del aorta abdominal e de su brancas. Un delineation clar de ille vasos es obtenite, eliminante in le majoritate del casos le necessitate de replenation directe del aorta per medio de un catheter o per le via translumbar. Le methodo merita esser introducite prestemente in le investigation de patientes hypertensive, particularmente de patientes in le gruppos de etate plus juvene in qui le hypertension se declara subitemente.

Anormalitates anatomic del vasos renal es ben documentate, e disparitates in le precoce effecto nephrographic in le duo renes provide un nette indication de ischemia renal unilateral que es un reflexion del capacitate reno-vascular plus tosto que del excretion tubular. Il pare indicate utilisar tomographia durante le phase aortographic del nephrotomographia pro obtener un plus adequate demonstration del normalitate o del anormalitate del vasos que alimenta un lesion neoplastic del renes.

Altere portiones del systema circulatori se presta probabilemente al demonstration radiographic per angiotomographia tanto prestemente como le aorta e su brancas principal.

Le technica es describite.

Rational Dosage in I^{131} Treatment of Hyperthyroidism[1]

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A RATIONAL APPROACH to the problem of dosage in treating hyperthyroidism with I^{131} was developed following a review of cases seen in the Radioisotope Clinic of the Jewish Memorial Hospital in New York and in the private practice of the authors over the past seven years. The combined series numbered 294 patients (237 female and 57 male), and in the course of the study, several points of interest emerged. Most striking was the smallness of the dose used in the earliest cases. In 1952 and 1953 the Clinic was feeling its way along, and initial doses of the order of 3 and 4 millicuries were routine. It was felt at the time that a small dose, repeated at suitable intervals, was safer for the patient than a single much larger dose. It soon became evident, however, that the additional doses were often not needed; the initial small dose of a projected series became the total dose; and remissions lasting up to eight years at the time of writing were regularly observed.

The administered dose was calculated for each patient individually, and while it is freely admitted that the accuracy of the gland weight and the effective half-life of the isotope may be questioned, the end-results proved that the average dose given to these patients was significantly less than in most comparable series. Throughout this discussion, following radiological usage, the term "dose" is used to represent the amount of administered material, measured in millicuries; the term "dosage" represents the absorbed radiation, measured in rads. The various tabulations which follow summarize the results of the study; the many cases seen more recently increased the numbers but did not alter the conclusions drawn.

The clinical diagnosis of hyperthyroidism was confirmed in each case by the "radioiodine thyroid profile" described in a previous paper (1), and, in appropriate cases, by other laboratory tests. The "thyroid profile" has proved to be an invaluable diagnostic tool. It represents the determination, by means of a single tracer dose of 50 microcuries of I^{131}, of the twenty-four-hour uptake, the conversion ratio, and the salivary radioactivity. When the indication for radioiodine treatment of an individual case was established, a therapeutic dose, calculated as detailed below, was administered. The response was evaluated clinically at about monthly intervals, and periodically checked with radioiodine studies, which consisted, in these post-therapy cases, of twenty-four-hour uptake and salivary radioactivity determinations. The conversion ratio was omitted because there has been considerable doubt as to its validity in these treated cases. On the other hand, the salivary radioactivity, in spite of the theoretical objections to its use, provided pathognomonic data in many cases that were obscure on other grounds, and proved to be most helpful in practically every instance.

Dose calculation for the radioiodine therapy of hyperthyroidism has been a vexing problem. Some clinics have adopted a standard dose, which may be varied within narrow limits, for all cases. Others employ formulas of varying degrees of complexity; one goes to the extent of performing air insufflation about the thyroid in an effort to determine the gland weight more accurately (2). Most formulas for calculating the dose simply figure anywhere from 60 to 250 microcuries of I^{131} per gram of gland. A moment's reflection, however, will show that a gland which is concentrating iodine at the rate of 90 per cent (uptake) will need less

[1] From the Radioisotope Service, Jewish Memorial Hospital, New York, N. Y. Presented at the Forty-fifth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 15–20, 1959.

than a gland of the same size with a concentration rate of 50 per cent; the latter will utilize only half the administered dose compared to the 90 per cent utilization by the former. Originally introduced for the purpose of training residents in a largely uncharted field, the scheme shown in Table I was evolved.

TABLE I: SCHEME FOR ADMINISTERED DOSAGE

Age Group	Dosage Range (rads)	Average Dosage (rads)
Young (up to 40)	3,000–9,000	6,000
Middle (40 to 60)	6,000–12,000	9,000
Older (above 60)	9,000–15,000	12,000

Within each age group, two factors dictated the actual dosage: the clinical toxicity (the more toxic the goiter, the smaller the dose) and the character of the gland (nodular goiters receiving higher dosages than diffuse goiters). For example, a middle-aged patient with Graves' disease of moderate toxicity might be assigned a dosage of 10,000 rads; a similar patient in the younger age bracket might receive 6,000 rads.

The dosage in rads was then translated into the dose in millicuries by means of a modified and simplified Marinelli-Quimby-Hine formula (3):

$$\text{Dose } (\mu c) = \frac{\text{rads} \times \text{weight of gland} \times \text{physical half-life}}{\% \text{ uptake} \times \text{effective half-life} \times (\text{equivalent roentgens}/\mu c \text{ gm./of tissue})}$$

$$= \frac{\text{rads} \times \text{weight} \times 8}{\% \text{ uptake} \times 5 \times 160}$$

$$= \frac{\text{rads} \times \text{weight}}{\text{uptake}}$$

For example, the middle-aged patient mentioned above, with a diffuse enlarged gland weighing 40 grams and an uptake of 60 per cent, should receive 10,000 rads. Solving the formula,

$$\text{Dose } (\mu c) = \frac{10{,}000 \times 40}{60} = 6{,}666\ \mu c = 6.7\ \text{mc } I^{131}$$

The younger patient, with identical factors would receive:

$$\text{Dose } (\mu c) = \frac{6{,}000 \times 40}{60} = 4{,}000\ \mu c = 4.0\ \text{mc } I^{131}$$

In deriving the simplified formula above, the effective half-life is assumed to be five days. It may, of course, vary widely from this figure; it could be any number up to eight. Unfortunately, there is little correlation between the effective half-life as measured from a tracer dose and that from a therapeutic dose, so that this important measurement can be made only after treatment (4). In a group of cases where the effective half-life was calculated, the dosage of radiation which the gland received was often found to differ appreciably from the dosage from which the administered dose was calculated. Despite this, the use of the formula tended to keep the administered dose well below those of most published reports, without altering unfavorably the end-results.

In the entire series, 10 patients had been observed for seven years; 16 for six years; 24 for five; 28 for four; 33 for three; 130 for two; and 55 for one year at the time of tabulation. These figures demonstrate the increasing popularity of the treatment; it will be noted that there is an increase in the number of cases treated each year except the last. This recent drop in the number of cases is attributed to the rapid growth of other facilities administering the treatment; the authors' private cases shared in the increase, in contrast to the pronounced drop in clinic patients.

Age	No. of Cases
Below 20	2
21–30	34
31–40	50
41–50	79
51–60	75
61–70	40
71–80	14

The age of these patients ranged from sixteen to eighty-six years. The bulk of the cases were in the middle-aged group, from forty to sixty, as would be expected. It is significant, however, that 86, or 29 per cent of the total, were below the age of forty. Many of these showed such absolute indications for radioiodine therapy as postoperative toxic recurrences or concurrent conditions which contraindicated surgery, but a large group of these younger

TABLE II: RESULTS OF TREATMENT

Dose (mc.)	Diffuse		Nodular		Post-Thyroidectomy		Total Remission
	Remission	Not Improved	Remission	Not Improved	Remission	Not Improved	
1–3	31	1	6	0	11	1	48 (16%)
3–4	30	2	7	0	2	0	39 (13%)
4–5	31	3	7	0	1	0	39 (13%)
5–6	25	1	9	0	5	1	39 (13%)
6–7	14	2	7	0	1	0	22 (7%)
7–10	15	0	11	1	4	0	30 (10%)
10–20	25	2	15	3	3	0	43 (15%)
Above 20	2	0	1	2	1	0	4 (1%)
TOTAL	173	11	63	6	28	2	264 (90%)

patients received I^{131} as the initial treatment. In fact, the young woman with Graves' disease can almost be assured of a successful and fairly prompt cure with this modality. It is, of course, the fear of carcinogenesis that is the main deterrent in the treatment of these young people; not enough time has elapsed since the first patient was treated in 1942 for the twenty-year interval that is necessary for the development of radiation-induced cancer. In time, case reports of carcinoma developing in I^{131}-treated hyperthyroidism will undoubtedly appear in the literature; the chance occurrence of such neoplasms can almost be predicted on a purely statistical basis. In spite of a diligent search, however, no unequivocal case has yet come to the attention of the authors.

Leukemogenesis is likewise a theoretical risk but, although sporadic cases of leukemia developing in I^{131}-treated cases have appeared (5), the incidence is apparently no greater than in the general population.

Another possible hazard is genetic damage by irradiation of the gonads by blood-borne I^{131}. A 10-millicurie dose of I^{131} will deliver 1.25 rads to the ovaries (6); yet the everyday procedure of x-raying the gastrointestinal tract will deliver up to four times that dosage. Kaplan (7) has treated over 800 women with anovulatory sterility by x-irradiation in dosages up to 80 rads directly to the ovaries. Only 3 minor malformations have appeared in the progeny of these patients. This is certainly no greater than would be expected on a statistical basis. The argument of the geneticists that malformations may appear at the fourth or subsequent generations can, of course, be answered only with time. We can certainly say that, as of now, the tiny amount of radiation received by the ovaries from blood-borne I^{131} has exerted no noticeably deleterious effect. In the present series, 5 of the patients are known to have conceived and been delivered of normal offspring after receiving therapeutic doses of I^{131}.

In any event, the theoretical risk involved in the use of ionizing radiation must be weighed against the definite risk associated with any other modality of treatment in each individual case.

Although enlargement of the gland is considered one of the important signs in thyrotoxicosis, about a third of the cases, including the postoperative recurrences, showed no gross palpable enlargement. The size of the gland is a matter of some importance, since its weight is one of the factors in the dosage formula. The glands which showed no palpable enlargement were considered to weigh 25 grams, the weight of the average normal gland. A surprising degree of unanimity in estimating the size of the gland was developed with increasing experience by the different members of our group. Palpable nodules were found in one-quarter of the patients (71); except for the 30 post-thyroidectomy cases, the remainder were diffuse toxic goiters, classical Graves' disease. The bulk of the cases (176, or 60 per cent) were treated as primary, having received no previous treatment of any sort; 30,

or 10 per cent, were postoperative recurrences, and the remainder had received medical treatment of one sort or another for varying periods before I^{131} therapy.

Study of Table II shows that 48 cases (1 out of 6) went into remission with a dose of 3 millicuries or less. Each additional millicurie dose, up to a total of 6 millicuries, resulted in an additional 13 per cent remission, so that over half the cases in the whole series responded to a dose level of 6 millicuries or less. The higher dose levels, except in the nodular group, represent the sum of multiple smaller doses. The overall remission rate was 90 per cent. It will be seen that the failures in the diffuse group were mainly in the lower dose ranges; these obviously represent the administration of only a single dose which did not bring about the desired improvement, whereupon for one reason or another the case passed out of our control. The failures in the nodular group were mainly in the higher dosage range, as would be expected. On the whole, the diffuse cases did better with lower dosage than the nodular, a finding reported by most other authors.

TABLE III: NUMBER OF DOSES

Number of Doses	Diffuse Cases	Nodular Cases	Total Cases
1	149 (70%)	45 (58%)	194 (66%)
2	41 (19%)	23 (29%)	64 (22%)
3	17 (8%)	8 (10%)	25 (7.5%)
4	6 (2%)	2 (2%)	8 (3%)
5	1 (0.5%)	1 (1%)	2 (1%)
6	1 (0.5%)	0	1 (0.5%)
TOTAL	215 (100%)	79 (100%)	294 (100%)

Table III demonstrates that approximately two-thirds of the total cases (194 out of 294) were controlled with a single dose; two-thirds of the remaining cases (64 out of 100) were controlled by a second dose; two-thirds of those still remaining (25 out of 36) needed a third dose; and two-thirds of the final remainder (8 out of 11) needed one more dose. In other words, an individual had a 66 per cent chance of control with a single dose; for the one-third not controlled, there was a 66 per cent chance that the second dose would achieve the result, and so on. A patient thus stands a two-to-one chance of control by any individual dose.

The diffuse goiters did somewhat better than the nodular type; 70 per cent of the former compared with 58 per cent of the latter received only one dose. One diffuse and one nodular goiter needed 5 doses, and one diffuse required 6 doses (totaling 36 millicuries) before control was achieved. It is interesting that in 88 per cent of all patients, the goiters, diffuse and nodular, were controlled by one or two doses, figures similar to those of other investigators (8).

TABLE IV: EXOPHTHALMOS

Severity	Cases (no.)	Results		
		Improved	No Change	Worse
+	21	8	13	0
++	28	14	14	0
+++	15	6	8	1
++++	17	10	6	1
TOTAL	81	38 (48%)	41 (50%)	2 (2%)

A total of 81 cases of exophthalmos, of varying degree, occurred in the series. There was moderate aggravation of the condition in 2; the remainder were unchanged or somewhat improved after treatment. No case was severe enough to require specialized treatment for the eye condition. Exophthalmos appearing after a remission was not observed in this series, although 1 such case, unilateral exophthalmos appearing six months after remission, has since been seen.

A transient thyroiditis, manifested by pain, tenderness, and slight fever, was experienced by 4 patients within two weeks after administration of the radioiodine; this invariably subsided without further incident. Five patients, 4 of whom became hypothyroid, complained of varying degrees of hair loss. This was also seen in one toxic case before treatment, and is a not uncommon complaint in the euthyroid population. One fatal case of thyroid crisis occurred early in the series in a severely toxic young girl; this case was similar in many respects to other reported cases (9).

The commonest undesirable side effect

of radioiodine therapy of hyperthyroidism is of course hypothyroidism. This developed in 24 cases in this series, in 18 cases within one year, and subsequently in 6. Several early mild cases reverted spontaneously to euthyroidism, but in no instance did this occur where the hypothyroid symptoms had lasted over three months. The 8 per cent incidence of hypothyroidism in this series compares favorably with that of most other authors and, indeed, with the results of surgical treatment. While hypothyroidism is not a serious complication, it is felt that the use of small doses helps to minimize its occurrence.

SUMMARY

Two hundred and ninety-four cases of hyperthyroidism treated with I^{131} at the Radioisotope Clinic of the Jewish Memorial Hospital, New York City, and in the private practice of the authors were reviewed. By and large, the results obtained in this series echo those of numerous other investigators, but several points are singled out for discussion. A plea is made for a rational scheme of dosage, even though this must be based on some arbitrary factors. A modified Marinelli-Quimby-Hine formula was employed, resulting in therapeutic doses that tend to be significantly lower than those in most comparable series. Since the remissions parallel those of most other authors, the smaller doses used are advantageous in at least two respects: they probably reduce the incidence of hypothyroidism (in this series 8 per cent), and they lessen the theoretical risk associated with ionizing radiation. The series as a whole is analyzed with the usual tabulations: age, number, and size of doses, end-results, etc. Considerable discussion is devoted to the gradually receding contraindications to radioiodine therapy, especially the younger age limits at which treatment will be undertaken. It is pointed out that in any individual case where therapy with I^{131} is considered, one must weigh the theoretical risk inherent in the use of ionizing radiation against the definite risk associated with any other modality of treatment.

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SUMMARIO IN INTERLINGUA

Dosage Rational in le Tractamento de Hyperthyroidismo per Medio de I^{131}

Le problema del tractamento de hyperthyroidismo per medio de I^{131} esseva studiate in un revista de 294 casos (237 femininas e 57 masculos) vidite in le curso de un periodo de septe annos. Le doses administrate in iste serie tendeva a esser plus micre que illos usate in le majoritate del comparabile series. Le schema de

dosage del autores (i.e., le schema del radiation absorbite) provide 6.000 rads pro patientes de etates de usque a cinquanta annos, 9.000 rads inter quaranta e sexanta annos, e 12.000 rads a etates de plus sexanta annos. Isto se traduce in dosage administrate, exprimite in millicuries, secundo un modification del formula de Marinelli-Quimby-Hine, prendente in consideration le peso del glandula e le prorata del captation in le caso individual. Plus que un medietate del casos respondeva a un dose de 6 millicuries o minus.

Remissiones de un duration de usque a octo annos (al tempore del presente reporto) esseva observate regularmente. Viste que iste resultatos es parallel a illos obtenite per le majoritate del altere autores, il es opinate que le reducite doses ha duo avantages: Il pare que illos reduce le incidentia de hypothyroidismo (24 casos in le presente serie) e, in plus, reduce le riscos associate con radiation ionisante. Iste riscos—le riscos del radiation ionisante—debe in omne caso esser ponderate contra le riscos associate con le un o le altere modalitate possibile de tractamento pro omne patiente individual.

In approximativemente duo tertios del casos (184 ex 294), le regulation del condition esseva effectuate per medio de un sol dose. In duo tertios del resto, un secunde dose esseva sufficiente. In duo tertios del resto de iste sub-gruppo, un tertie dose sufficeva, e assi de plus, usque a un total de 6 doses (o 36 millicuries) que esseva administrate a un patiente con struma diffuse. Octanta-octo pro cento de omne strumas, diffuse e nodular, esseva regulate per un o duo doses.

Le complicationes in iste serie esseva relativemente pauco numerose. Un crise thyroidic occurreva in un caso e se terminava in le morte del patiente.

Assessment of the Radiation Dose Due to Fall-Out[1]

P. F. GUSTAFSON, Ph.D.

THE TESTING of nuclear weapons during the past decade has resulted in environmental radioactive contamination of world-wide proportions. The degree of contamination varies with the geographical location, depending primarily upon the position of the area relative to the testing sites, the amount of rainfall, and the latitude (1). The variation in fall-out deposition with latitude is illustrated in Figure 1. This is the distribution pattern for fall-out coming from the stratosphere, which is the primary source of deposition.

Of the many radioelements produced in the fission process, Sr^{90} and Cs^{137} have been examined most thoroughly because of their high fission yield, long radioactive half-lives, and chemical properties that readily permit entry into the biosphere, including man himself. Many factors relevant to the processes whereby these radioisotopes enter the food chain and are deposited in the human body have been qualitatively assessed (2, 3). The human body burdens of Sr^{90} and Cs^{137} have been measured as a function of time, and thus the radiation doses arising from such internal deposition may be calculated (4, 5). A second source of radiation from fall-out consists in gamma-emitting fission products external to man, which are capable of delivering a dose often many fold greater than that due to Sr^{90} and Cs^{137} combined. This presentation will be concerned with this external dose, its measurement, its variation in time, and its magnitude compared with the dose from natural background radiation.

Measurements of gamma-ray-emitting fission products have been made periodically on soils collected at the Argonne National Laboratory site since the spring of 1957. The measuring technic employed

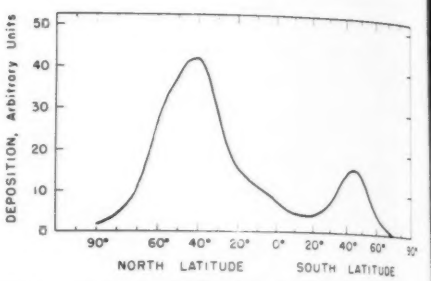

Fig. 1. Latitude distribution of stratospheric fall-out.

was gamma-ray spectrometry of soil samples of finite size (1–2 kg.), with a 5 × 4-in. NaI crystal and an Argonne Type 256 channel analyzer (6). The soil was arranged geometrically, by means of a stainless steel container, in a 1-inch layer around and over the crystal. Background reduction, essential for the detection of the quantities of activity involved (approximately 10^{-10} curie of Cs^{137}/kg. of soil), was effected through the use of thick steel shielding around the sample and detector.

Soil sampling was done to a depth of 6 inches, which includes essentially all fission products present in a given area. Two gamma-ray spectra of soil taken with a NaI crystal are shown in Figure 2. The one from deep soil is free of any fission activity and contains only Th, U, and K^{40}. The other, from soil to a depth of 6 inches collected in July 1959, indicates the presence of two peaks not evident in the first case. One peak is due to Zr^{95}-Nb^{95} and the other to $Ru^{103, 106}$.

The concentration of fission and natural radioactivity in soil was determined by the use of sources of known activity incorporated in mock soil (Na_3PO_4). This method presupposes knowledge of the various isotopes present in the soil. The standard reference spectra, one for each isotope, permit setting up the fraction of the total

[1] From the Division of Biological and Medical Research, Argonne National Laboratory, Lemont, Ill. Presented at the Forty-fifth Annual Meeting of the Radiological Society of North America, Chicago, Ill., November 15-20, 1959.

This work was performed under the auspices of the U. S. Atomic Energy Commission.

TABLE I: GAMMA-RAY EMITTING FALL-OUT RADIOACTIVITY ON THE GROUND AT ARGONNE NATIONAL LABORATORY (mc/sq. mile)

Isotope	1957 May	1957 July*	1957 Oct.	1958 April	1958 July	1958 Sept.	1959 March	1959 April	1959 May	1959 June	1959 July
Zr^{95}-Nb^{95}†	180	195	230	200	95	315	731	980	1,043	917	756
Cs^{137}	35	34	37	45	60	82	128	135	141	147	152
Ru^{106}	175	180	180	170	150	210	624	812	881	1,173	1,202
Ru^{103}	175	200	240	130	35	80	331	230	186	120	88
Ce^{141}	110	120	140	60	15	50	580	329	268	182	113
Ce^{144}	240	260	275	250	215	270	1,127	1,450	1,533	1,704	1,812
TOTAL‡	1,095	1,184	1,332	1,055	665	1,322	4,252	4,916	5,095	5,160	4,879

* Soil collected 40 miles from the Argonne site gave essentially the same results as the Argonne National Laboratory soils, indicating that any contamination from the reactors at Argonne is of secondary importance in this study.

† Assuming Zr^{95}-Nb^{95} to be in equilibrium.

‡ Totals include activity due to both Zr^{95} and Nb^{95}, *i.e.*, for May 1957, 360 mc/mi² from these two isotopes.

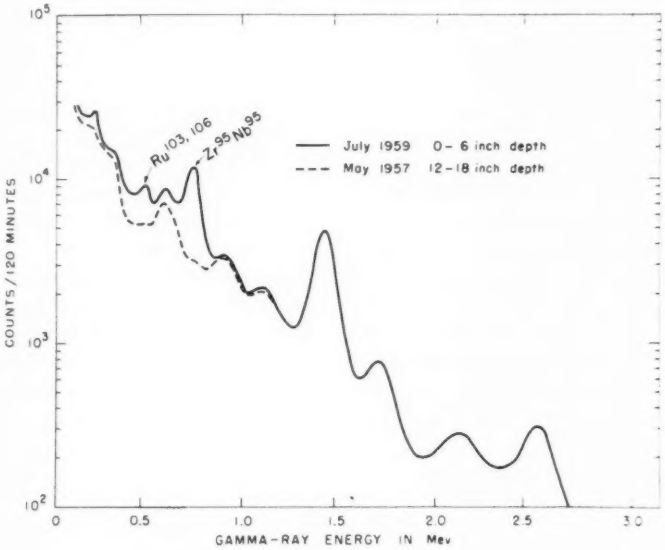

Fig. 2. Gamma-ray spectra of soil.

counting rate occurring in each spectral region, there being as many regions as there are isotopes. Thus the solution of the appropriate number of simultaneous equations yields the concentration of each radionuclide in the soil being analyzed. The errors involved in such a procedure were estimated by preparing and counting a mock sample consisting of known amounts of the various isotopes, and then solving the pertinent equations. Comparison of the analytical results with the amounts known to be present provides a measure of the error. The error in determining Cs^{137}, for example, was on the order of 15 per cent; the errors for the other fission products were similar.

Table I lists the activity in mc/sq. mile of Zr^{95}-Nb^{95}, Cs^{137}, Ru^{103}, Ru^{106}, Ce^{141}, and Ce^{144} at various times since May 1957. Because of its twenty-seven-year half-life, Cs^{137} is a reliable indicator of the total fall-out accumulated at any given locality. These data show that the amount of Cs^{137} doubled between October 1957 and September 1958 and that it almost doubled again by the spring of 1959. No figures are given here for Sr^{90}, since it is not a gamma-emitting isotope. However, work done in collaboration

TABLE II: DOSE RATE DUE TO FALL-OUT AT ARGONNE NATIONAL LABORATORY (μrad/hour)
Natural Background = 11.12 μrad/hour

Isotope	1957			1958			1959				
	May	July	Oct.	April	July	Sept.	March	April	May	June	July
Zr^{95}-Nb^{95}	1.14	1.23	1.46	1.27	0.60	2.00	4.64	6.22	6.62	5.82	4.80
Cs^{137}	0.09	0.08	0.09	0.12	0.15	0.21	0.32	0.34	0.36	0.37	0.38
Ru^{106}	0.15	0.15	0.15	0.14	0.13	0.18	0.53	0.69	0.75	1.00	1.03
Ru^{103}	0.35	0.41	0.49	0.27	0.07	0.17	0.69	0.48	0.39	0.25	0.18
Ce^{141}	0.01	0.02	0.02	0.01	0.01	0.01	0.13	0.07	0.06	0.04	0.03
Ce^{144}	0.04	0.05	0.05	0.04	0.04	0.05	0.21	0.27	0.28	0.31	0.33
TOTAL	1.78	1.94	2.26	1.85	1.00	2.62	6.52	8.07	8.46	7.79	6.75

with the Health and Safety Laboratory of the Atomic Energy Commission demonstrates that there is a fairly constant ratio of 1.6 ± 0.2 between total Cs^{137} and total Sr^{90} activity in soil (7). Therefore one would expect the Sr^{90} activity to be roughly 0.6 that of Cs^{137}.

Thus the concentration of fission activity is measurable, and its distribution in depth within the soil also may be determined empirically. The dose arising from these various fission products may be calculated, with the assumption that the activity is spread uniformly on an infinite plane, according to the procedure of G. M. Dunning (8). Absorption and build-up factors have been included for the gamma-rays of each isotope, and the resulting dose rates are given in Table II. It should be emphasized that these dose rates in μrad/hr. have been calculated for an unshielded point one meter above the ground.

The calculated doses were compared with the dose measured with an appropriate ionization chamber at various times during 1959. In comparing calculated and observed dose rates, one must bear in mind that the measured dose contains components due to natural radioactivity and to cosmic radiation. The dose from U, Th, and K^{40} can be calculated from Hultqvist's equations, using the concentrations of these radioelements determined from gamma-ray spectrometry (9). The dose from cosmic radiation was taken from the literature (10). Table III shows the calculated dose for April 1959, totaling 19.2 μrad/hr., contrasted with a measured dose rate of 18.5 μrad/hr. Similar agreement was observed during the succeeding spring and summer months, lending support both to the method of calculation and to the method of measuring fission product concentration.

TABLE III: CALCULATED AND MEASURED GAMMA-RAY DOSE RATE ONE METER ABOVE GROUND AT ARGONNE NATIONAL LABORATORY APRIL 1959

	Calculated	Measured
Thorium	2.53 μrad/hour	
Uranium	2.65	
K^{40}	2.77	
Cosmic Radiation (10)	3.17	
Fall-out	8.07	
TOTAL	19.19 μrad/hour	18.48 μrad/hour

As previously stated, the dose rates given in Table II pertain to an unshielded point one meter above ground. The actual dose to which an individual would be exposed is modified by shielding and by the time spent out-of-doors. Again an ionization chamber was used to determine the dose rate indoors and outside at the Argonne site. The types of structures inside of which dose measurements were made included a wooden frame house with plaster inner walls, a brick building with plaster inner walls, and a brick building with cinder-block inner walls. Within the accuracy of measurement, a shielding factor of 5 was found for fall-out radiation (*i.e.*, the dose due to fall-out found to prevail indoors was one-fifth that found outside). Such a shielding factor is in agreement with that proposed by the United Nations as an average for structures of these types (11). An additional factor has been suggested by that body to account for weathering, which

lowers the dose because of leaching, wash-off, and other mechanisms which reduce the activity present. For the period from 1957 to 1959 no direct evidence was found at this laboratory which shows a downward movement of Cs^{137} in soil, nor has evidence been found for any of the other isotopes mentioned. For this period, therefore, no factor has been included for this type of dose reduction.

A unique situation exists at the present time for the study of fall-out mechanisms. Testing of nuclear weapons has ceased, and there is no further injection of fission debris into the stratospheric reservoir. Consequently, it should now be possible to obtain reliable values for fall-out rate and stratospheric storage time. Furthermore, since no new activity is being released, there is some justification for hoping that future levels of radioactivity and radiation in our environment may be predicted within reasonable limits of accuracy. To this end, monthly soil samples have been collected at Argonne since March 1959, and from these samples fall-out rates for each radioisotope mentioned have been determined. Interpretation is complicated by the fact that a portion of the fall-out at Argonne comes from tests conducted by the United States and the United Kingdom in the Pacific area and another portion from Russian tests carried out in the far North. The stratospheric storage times, and consequently the fall-out rates, appear to be substantially different for debris coming initially from these two locations (12, 13).

The best fit to our data is obtained by assuming that 60 to 75 per cent of the fall-out during the spring of 1959 is due to Russian tests, having a storage time of six to nine months, and that the remainder comes from Pacific tests, having a storage time of four years. This proportion appeared to continue into the summer[2].

Encouraged by the consistency of these findings, we made estimates of the future levels of external radiation and integral dose from such radiation on the assumption that testing is not resumed. It is to be emphasized that these figures actually pertain only to the Argonne site and its immediate surroundings. However, the similarity in Sr^{90} deposition at Argonne and at other localities throughout the North Central and Northeastern states implies that comparable fall-out levels exist over this area, which contains roughly one-half the population of the United States. Figure 3 indicates the gamma dose rate in μrad/hr. from all fission products, as well as that due to Cs^{137} alone, starting in 1957. As expected, after a few years the bulk of the external dose is due to Cs^{137}. The maximum dose rate from all fission material occurred in May 1959, and amounted to 8.46 μrad/hr. unshielded or 1.69 μrad/hr. indoors. This is in addition to the 11.12 μrad/hr. due to natural background. At the same time the whole-body dose from Cs^{137} within the body was calculated to be 0.2 μrad/hr., and that to bone from internally deposited Sr^{90} was calculated to be 0.3 μrad/hr. The total internal dose is thus about one-third that arising from external fission products indoors.

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[2] It is possible to compute the amount of any isotope in the stratospheric reservoir at any time by using the observed rate of fall-out, the above proportion, and a factor which takes into account the latitude distribution. Consider Cs^{137} for example: The fall-out rate as determined from soil data for this isotope in the period from March through July 1959, was 6 mc/mi^2/mo.; with a 60–40 per cent proportion, 4 mc/mi^2/mo. came from Russian tests and the other 2 mc/mi^2/mo. from Pacific tests. In November 1958, with six-month and four-year storage times for Russian and Pacific debris respectively, the stratospheric reservoir at 40° north latitude contained 117 mc/mi^2. The region 35° to 45° north comprises an area of 1.5×10^7 mi^2; thus the total stratospheric reservoir in this belt contained 1.5×10^7 mi^2 $\times$ 117 mc/mi^2 = 1.75 megacuries of Cs^{137}. Since approximately 25 per cent of the total world-wide deposition of Sr^{90}, and presumably, therefore, of Cs^{137} also, occurs in this latitude band, the entire reservoir contained four times this amount, or 7 megacuries of Cs^{137}. This figure is in fair agreement with the data reported by Libby (14), which indicated that, on the basis of air and rain sampling, in November 1958, there was on the order of 4 megacuries of Sr^{90} in the entire stratospheric reservoir, or 6.4 megacuries of Cs^{137}, through the use of the Cs/Sr activity ratio of 1.6.

In the period March to July 1959, the ratios of Ce^{141}/Zr^{95} and Ru^{103}/Zr^{95} activities in new fall-out indicated that they were produced in October 1958. On the other hand, the relative amounts of longer-lived Ce^{144}, Ru^{106}, and Cs^{137} coming down during the same time interval showed that a significant fraction (25–40 per cent) of these radionuclides arose from tests conducted prior to the fall of 1958.

TABLE IV: INTEGRAL DOSE TO MAN WITH TESTING STOPPED IN FALL OF 1958 (mrad)

Time Interval	Whole Body: External (γ-rays) A*	Whole Body: External (γ-rays) B	Whole Body: Internal (Cs^{137}) C	Whole Body: Internal (Cs^{137}) D	Total	Most Probable†	Bone (Sr^{90})	Background (Whole Body)
30 years	42	32	10	71	42–113	52 (1.4%)‡	40–160	3750
70 years	52	40	10	118	50–170	62 (0.7%)	93–372	8750

* A. Shielding factor of 5 for all fission products. B. Shielding factor of 5 and weathering factor of 2 for Cs^{137}. C. Cs^{137} body burden proportional to fall-out rate. D. Cs^{137} body burden proportional to accumulated fall-out.

† The presence of short-lived radionuclides, in addition to those considered, may increase the most probable thirty-year dose by 20 per cent and the seventy-year dose by as much as 10 per cent.

‡ Percentage of background dose.

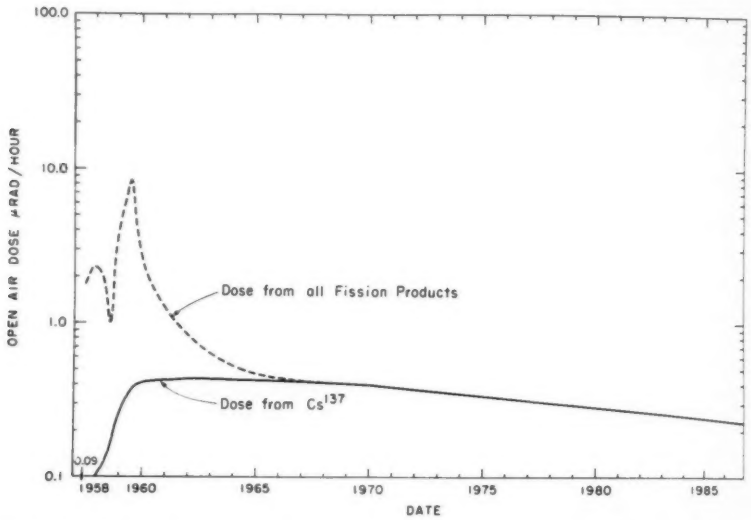

Fig. 3. Calculated gamma-ray dose one meter above the ground from fission products; tests discontinued in 1958.

The integral thirty-year and seventy-year whole-body doses to man from fall-out radioactivity were calculated for the present situation in which there has been no further testing since the fall of 1958. These doses, which have been termed the genetically significant dose and the life-time dose, respectively, are given in Table IV. The whole-body dose is composed of an external component, attenuated by the proper shielding factor, and an internal component from Cs^{137}. An additional source of internal radiation to bone exists due to the presence of Sr^{90}. Two assumptions were used in computing the external dose: (A) a shielding factor of 5 for all radionuclides, and (B) a shielding factor of 5 and a weathering factor of 2 for Cs^{137}. Computation of the internal dose from Cs^{137} also involved two different assumptions: (C) a body burden proportional to fall-out rate, and (D) a body burden proportional to the accumulated Cs^{137} deposition. With these assumptions, the calculated thirty-year dose ranged from 42 to 113 mrads and the seventy-year dose from 50 to 170 mrads. Investigations at Argonne have shown little downward migration of fall-out radio-elements up to mid-1959, which tends to support assumption (A). Studies of the concentration of Cs^{137} in milk and other foodstuffs have shown primarily a dependence upon fall-out rate, which in turn implies that the body burden will be rate-dependent according to assumption (C)

(2). Consequently the most probable values for the thirty-year dose and the seventy-year dose (assumption A plus C) are 52 and 62 mrads respectively. These compare with thirty- and seventy-year doses of 3,750 and 8,750 mrads respectively occurring from natural radiation and amounting to 125 mrads/year in the Chicago area. Thus fall-out radioactivity will result in a dose increment over and above that due to natural sources of 1.4 and 0.7 per cent for the thirty- and seventy-year periods respectively. Estimates of the dose to bone from Sr^{90} for these time intervals are also included in this table (15).

Consideration has also been given to the whole-body dose from fall-out in the event that testing continues for five years beyond 1958 at the 1954–1958 testing rate and for the situation in which testing continues indefinitely at this rate. The genetic and lifetime doses under these circumstances are presented in Table V

TABLE V: CALCULATED VALUES OF WHOLE-BODY DOSE

Conditions	30-Year Dose		70-Year Dose	
	mrads	Per Cent of Background*	mrads	Per Cent of Background
Tests continue for 5 years beyond 1959 at 1954–1958 rate	79	2.1	95	1.1
Tests continue indefinitely at 1954–1958 rate	234	6.2	546	6.2

*Values for natural background are 3,750 mrads for thirty years and 8,750 mrads for seventy years.

with the dose from natural sources included for comparison. It is calculated that continuous testing will result in an increase in whole-body irradiation of about 6 per cent above that coming from natural background.

It will be noted that no evaluation has been made of the dose due to I^{131}, man-made C^{14}, or other radionuclides known to be present in the body, either fixed in the tissues or merely passing through the gastrointestinal tract. As far as whole-body irradiation is concerned, these radioisotopes are of very little importance compared with the levels of fall-out radioactivity on the ground and Cs^{137} and Sr^{90} in the body.

SUMMARY

The procedures described and utilized in this report have made it possible to obtain a measure of the radiation dose arising from gamma-emitting fission activity on the ground. Evaluation of the whole-body dose to man from such a source has been made with the use of shielding factors applied to this gamma radiation. It has been calculated that the present situation, in which nuclear weapons testing is no longer being carried out, will lead to a thirty-year dose of 52 mrads and a lifetime dose of 62 mrads to roughly one-half the population of the United States. These are increases of approximately 1.4 and 0.7 per cent respectively over natural radiation. The continuous testing of nuclear weapons at the rate occurring between 1954 and 1959 would result in an increase of the whole-body dose of some 6 per cent over that occurring naturally.

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SUMMARIO IN INTERLINGUA

Evaluation del Dosage de Radiation per Precipitation Atmospheric

Mesurationes per medio de spectrometria a radios gamma visante a determinar le magnitude del radiation per precipitation atmospheric al nivello del superficie terrestre es in progresso al Laboratorio National Argonne depost le secunde medietate del anno 1957. Isto ha permitte determinar, in mc/mi², le activitate del varie productos de fission presente. Super le base de iste determinationes, le doses recipite per le homine es calculate con le supposition que le activitate se extende uniformemente in un plano infinite. Le factores del absorption e del accumulation es includite in le radios gamma de cata un del isotopos, e le resultante dosages es presentate in forma tabular. Le validitate del calculationes esseva demonstrate per comparationes con lecturas ab cameras de ionisation.

Le calculationes monstra que si le presente situation continua, i.e., que si le tests de armas nucleari remane suspendite, le resultato va esser un dose trentena de 52 mrad e un dose de 62 mrad durante le vita pro grossiermente un medietate del population del Statos Unite. Iste valores representa augmentos de approximativemente 1,4 e 0,7 pro cento, respectivemente, in ultra del radiation natural. Le continuation del tests de armas nucleari al grados de intensitate que prevaleva inter 1954 e 1959 resultarea in un augmento del dosage al corpore total de 6 pro cento in ultra de lo que occurre naturalmente.

A New Design for Barium Rectal Tube[1]

EDWIN L. LAME, M.D.

FOR SOME years there has been a need for a better rectal tube for barium-enema study of rectal and low sigmoidal lesions. The requirements have been two:

(1) A tube that will permit direct measurement on the film of:
   (*a*) The dimensions of a lesion
   (*b*) The distance of a lesion from the anus or rectosigmoid junction (the surgeon is the person most interested in these data).

(2) A tube that will increase accuracy of diagnosis in the rectosigmoid area.

A rectal tube has been designed and used for over two years with gratifying results. It has satisfied the requirements and does not increase the discomfort of the patient or the difficulty of the examination. The greater length of the balloon tip has offered no technical disadvantages.

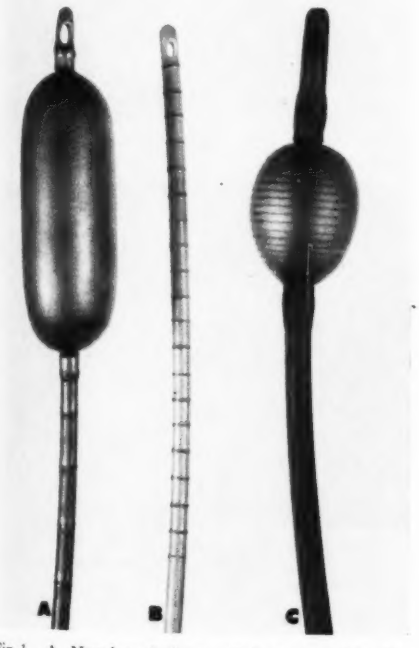


Fig. 1. A. New long balloon, 10 × 5 cm. when distended; lead rings embedded in catheter wall at 2-cm. intervals.
B. Same catheter without balloon (this illustrates the first, more costly model with lead at 1-cm. intervals).
C. Catheter of usual variety, for comparison of balloon size.

Fig. 2. Chronic ulcerative colitis with rigidity and stenosis well shown by long balloon contour.

The tube is made with lead rings embedded at 2-cm. intervals over a distance of 20 cm. from the leading end (Fig. 1). This permits the direct film measurement of the dimensions of a lesion (Fig. 2) and determination of its distance from the anus. This last may be accomplished by placing any opaque object against the anus when filming, or, with experience, it can be estimated without this aid, since the lower edge of the balloon is almost always at a distance of 2 cm. from the anus (Fig. 2).

[1] From the Department of Radiology, Presbyterian Hospital, Philadelphia 4, Penna. Accepted for publication in September 1959.

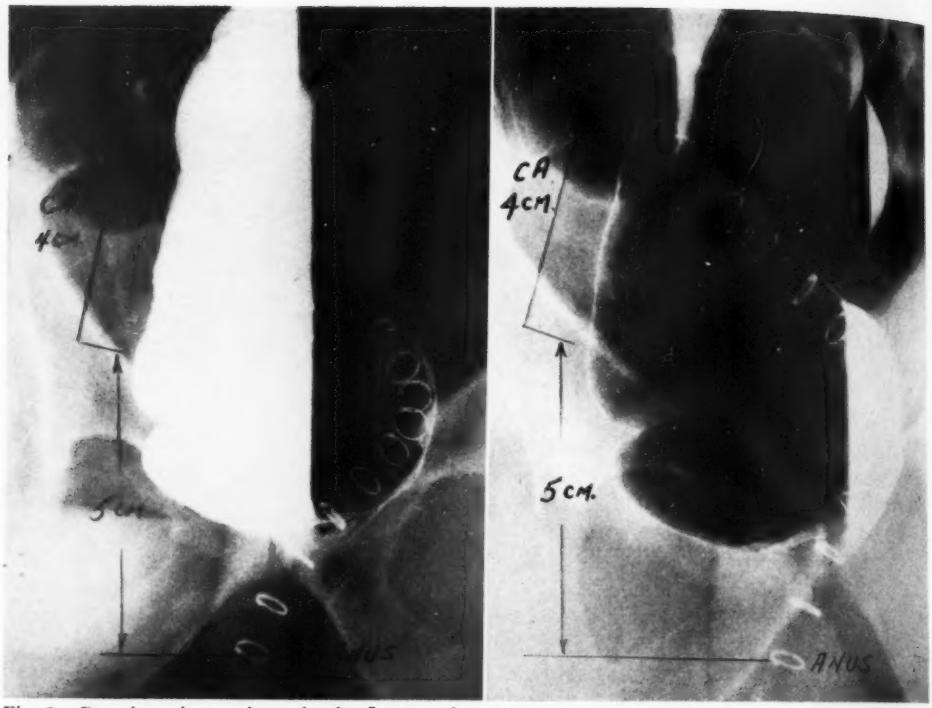
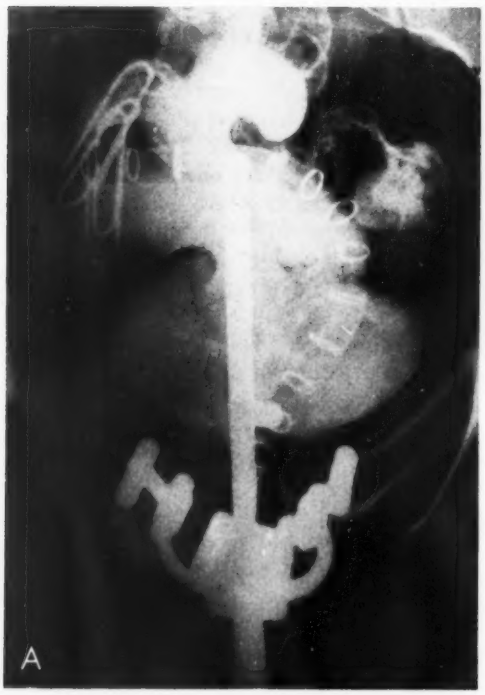


Fig. 3. Rectal carcinoma, lower border 5 cm. and upper border 9 cm. from anus, surgically confirmed. An elongated flat lesion.



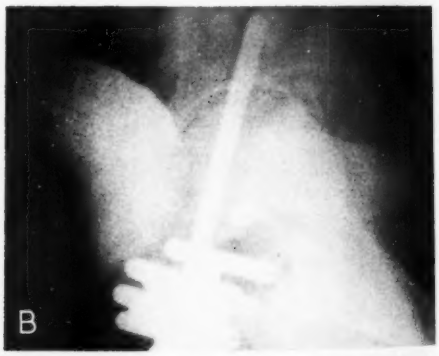


Fig. 4, A and B. Ernst applicator in place, with non-balloon calibrated catheter in the rectum to assist in measurement.

A long balloon (10 cm. long and 5 cm. wide when distended, and more than twice the volume of older types) is welded to the tube. This is comparable to rectal anatomy, creating increased rectal distention, more peripheral outline, and thus a greater double-contrast field. It offers several advantages:

(*a*) More small and flat lesions are demonstrated (Fig. 3).

(*b*) Medium-sized lesions that might lie wholly or partly above or below the smaller, older type of balloon are often completely surrounded by the large balloon and thus well shown (Fig. 3).

(*c*) High lesions, in or above the rectosigmoid junction, causing deviation of the upper surface of the balloon, are sometimes a valuable sign in difficult cases. The centimeter rings assist in demonstrating this deviation.

A further use of the calibration factor is in a simple nonballooon tube for instillation of barium into the rectum for measurement of distances in pelvic radium calculation, as shown in Figure 4. The tube in this illustration is an earlier, more costly type, having lead rings placed at each centimeter.

SUMMARY

A rectal tube has been designed with centimeter calibration to permit direct measurements of lesions on barium enema films. A large balloon is attached to increase accuracy of diagnosis.

The tube may be obtained[2] without the balloon for measurement of distances in pelvic radium calculation.

Department of Radiology
Presbyterian Hospital
Philadelphia 4, Penna.

[2] Manufactured by The American Cystoscope Makers, Inc., 8 Pelham Parkway, Pelham Manor, N. Y.

SUMMARIO IN INTERLINGUA

Un Nove Stilo in Catheteres Rectal a Barium

Esseva elaborate un nove stilo de catheter rectal, equipate con anulos de plumbo a intervallos de 2 cm pro permitter mesurationes directe de lesiones in pelliculas post clyster a barium e le determination del sito de tal lesiones in relation al ano. Un grande ballon es attachate pro augmentar le accuratia diagnostic. Le catheter pote esser comprate sin le ballon e usate pro mesurationes de distantias in calculationes de radium del pelvic.

Le catheter ha essite in uso durante plus que duo annos con resultatos gratificante. Ni le disconforto pro le patiente ni le difficultate del examine ha essite augmentate per su empleo.

SUMMARIO IN INTERLINGUA

Un Incostose Dispositivo pro le Injection Rapide de Substantia de Contrasto

(*Pagina 292*)

Un incostose dispositivo pro le rapide injection de substantia de contrasto es describite. Illo es construite principalmente ex tubos e connexiones galvanisate standard de diametros de 1/2 e 3/8 pollices del typo usate in le plumberia. Depost su construction, le dispositivo ha essite usate satisfacentemente in omne typos de examines requirente le rapide injection de substantia de contrasto.

Inexpensive Device for Rapid Injection of Contrast Material[1]

GEORGE C. SUTTON, M.D., and HOWARD C. BURKHEAD, M.D.

AN INEXPENSIVE device for the rapid injection of contrast media can be constructed largely from standard galvanized iron pipe and fittings 1/2 inch and 3/8 inch in diameter, such as may be obtained from any plumbing supply store. A stainless steel otolaryngeal syringe[2] of 90 c.c. capacity is held in place by wood blocks at either end and the assembled device is mounted on a wood panel (Fig. 1). The ear piece of the syringe is replaced by a Luer-Lok device. A short malleable connector bent to a right angle completes the arrangement. Not shown in the illustration is a 4-inch wood clamp for securing the base board to the table on which the apparatus rests, at the point indicated by the arrow.

With a 3-foot pump handle as a lever, 90 c.c. of warm contrast material can be injected through a 125-cm. F.8 Lehman catheter in three seconds.

The apparatus is assembled with simplicity, and the cost is moderate, in the neighborhood of $30. Since its construction it has been used satisfactorily at the Evanston Hospital in examinations of all types requiring rapid introduction of contrast material.

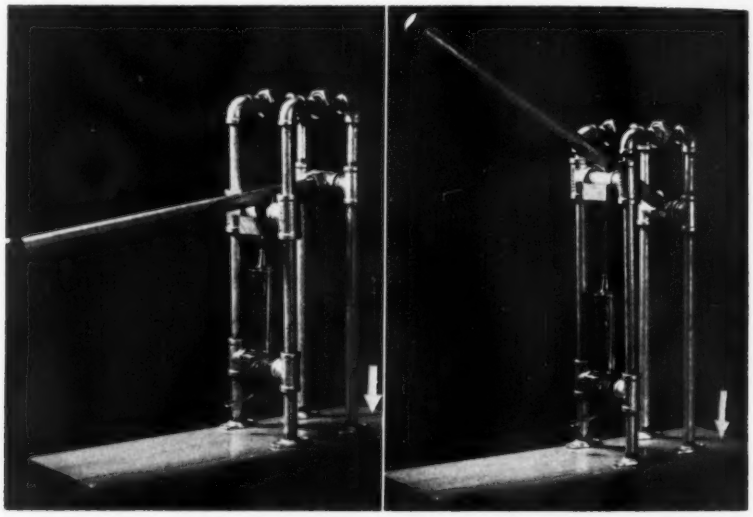


Fig. 1. Construction and operation of device for rapid injection of contrast material.

Evanston Hospital
2650 Ridge Ave.
Evanston, Ill.

(*Pro le summario in interlingua, vider le pagina 291*)

[1] From the Departments of Medicine and Radiology, Evanston Hospital Association, Evanston, Ill., and Northwestern University. Accepted for publication in December 1959.

[2] Syringe Model: AU-501, V. Mueller & Co., Chicago, Ill.

EDITORIAL

The Roentgenologist as a Consultant

The rendition of a signed report to the referring physician is an important part of the practice of diagnostic roentgenology. This report, based upon examination of the patient, presents the findings of the roentgenologist and expresses his medical judgment or diagnosis. Because definite responsibilities have been assumed in the performance of such an examination, no matter how simple it may be, the report should show that these commitments have been honored.

What exactly are these responsibilities? In what manner are they best discharged?

Evaluation: In most cases the evaluation of an x-ray examination as to suitability, completeness, and technic requires no direct mention by the roentgenologist. This holds true particularly for the simpler and more standardized procedures. Occasionally, however, it is necessary that a statement be included pertaining to one or another of these three conditions any one of which can be of real significance to the patient and the referring physician.

In order to pass on the suitability of any examination that the roentgenologist may be called upon to interpret, a clear statement is required from the referring physician as to the information sought or, in other words the purpose of the roentgen study that has been requested. Unless such information is provided, one is unable to determine whether or not the examination chosen was the one best suited to the purpose.

If doubt exists in the mind of the referring physician as to the correct x-ray procedure in a particular situation, then a consultation with the roentgenologist is in order. Usually, however, it is simpler if the patient is turned over to the roentgen diagnostician who, being informed of the problem to be answered, is left free to choose the most efficient way to proceed with his work-up. Should it transpire that an inappropriate examination has been carried out, then the report must define its ill conception and state the correct method of approach to the problem. In this manner the patient's interest will be protected and similar errors may be prevented in the future.

The second part of the evaluation concerns the presence of any restrictions on the conduct or execution of the roentgen examination. Restrictions which can lead to an examination that is less than complete, may emanate from the referring physician or from the patient himself. Stipulations imposed by the referring physician, although well intended, are often unwise and founded upon commonly held misconceptions. The failure to permit adequate preparation of a patient, the insistence on the use of certain types of radiopaque material, such as "thin barium," and the rigid designation of technical matters can seriously undermine the usefulness of the roentgen method. To the extent that an x-ray study is compromised in these ways are the chances for a successful result diminished. The roentgen report must always specify and frankly appraise the consequences of any deficiencies of this sort. The second group of curtailments in the conduct of his work that the roentgenologist may encounter derive from the condition of the patient. Mental disturbances and various physical disabilities exact their toll from the potentialities of diagnostic roentgenology. Pertinent clinical information dealing with certain of these matters is needed and appreciated by the roentgenologist. When these limitations assume significant proportions, the

report must clearly state the deficiencies they have occasioned.

The last part of the evaluation concerns technic. Roentgenologists cannot ignore the quality of the films upon which their medical diagnosis rests. An offer to repeat any film that falls below an acceptable standard should always be made in the report. By this approach the roentgenologist serves notice that he assumes the entire responsibility for the technical competency of his work. This attitude tends to forestall arguments with colleagues regarding the quality of a film.

Detection: The detection of an abnormality, or conversely its exclusion, constitutes the most important contribution of diagnostic roentgenology. Experience proves that a marked degree of accuracy can be attained in either instance, providing roentgenologically identifiable lesions are concerned and if judgments are rendered by competent examiners. Also, the technic must be acceptable and no serious restrictions should be placed upon the conduct of the examination.

It is not sufficient, however, to discover one abnormality and then to quit. It is required that every lesion of potential significance present anywhere on the films or on the screen be detected and reported. This insures that incidental information, sometimes vitally significant to the patient, will not be overlooked. Because the training and experience of the roentgenologist encompass the entire field of medicine as it relates to the roentgen method, he is the one physician capable of discharging this responsibility.

Roentgenologic detection of disease is subject to two limitations. The first is inherent in the method itself, for obviously roentgenology is limited to the recognition of macroscopic disease. Consequently, when the size and shape of the smallest defect or earliest evidence of a particular disease have once been established, the potential of the roentgen method for detection in that situation is expressed. Not only does this determination define the inherent limitation of diagnostic roentgenology for the particular disease and organ concerned, but it also sets the goal of proficiency toward which the individual roentgenologist continuously aspires.

The second limitation of roentgen detectability is determined by the training, experience, interest, and ability of the examiner himself. A sharp distinction must always be made between these two different sorts of limitation, one impersonal, fixed, and insurmountable; the second individual, personal, variable, and almost always subject to improvement. The first determines what the method is capable of accomplishing. The second expresses what the examiner can do.

Description: The next section of the roentgen report should provide a thorough description of each of the abnormalities that have been brought to light. Abnormalities in the form, density, and motion of the x-ray shadows caused by a lesion must be translated into an exact word picture which reveals the gross pathology and pathological physiology found to exist. The roentgenologist's aim should be to present his information so clearly and reliably that the referring physician will always gain more by reading the roentgen report than by having to inspect the films.

Roentgenologic description is indeed a difficult art and it constitutes a major part of competent reporting. Technical jargon is to be avoided. Words subject to variable interpretation such as massive, huge, small, and minute should not be used. Instead actual measurements, in three dimensions if possible, and gradients of change as expressed in percentages or degrees are preferable. The standard terminology of anatomy, physiology, and pathology is the only acceptable language when one undertakes the translation of x-ray findings into final form in the report.

Beside an evaluation of size, shape, and function, localization of the lesion within an organ or within the body itself is necessary. Also required is a description of significant relationships with other structures, and statements as to extension across boundaries, involvement of vital

organs, the number of multiple lesions and their distribution and pattern.

In putting together a successful roentgenologic description of a lesion, familiarity with the therapeutic principles entailed in its management is a necessity. Knowledge of this kind enables the roentgenologist to accord due emphasis in his description to the features of the disorder which are of practical significance to the physician who must carry out treatment. A report which is not oriented in this fashion bears the stamp of impracticality.

Comparison: The fourth division of the report is fundamental and yet it is often overlooked. Whenever possible the current examination should be compared with previous films and reports. Such a comparison should include all available studies whether done by the same examiner or others. A diagnosis not otherwise obtainable sometimes follows this procedure, since roentgenological judgments are often tenable only when formulated on a dynamic basis.

Diagnosis: A medical or roentgenologic diagnosis embodies several concepts. These are: first, the detection of a disease; next, a description of its extent and manifestations; finally, as exact a judgment as is possible as to its nature. In roentgenology in particular, detection and description are usually as important as a precise knowledge of the type of disease, sometimes in fact even more so.

Once a disease has been detected and described, roentgenologic judgment as to its nature may be specific, categorized, or general. Furthermore, each of these gradations of diagnosis can be further qualified as definite, probable, or possible. A careful consideration of all these matters indicates why the roentgenologist should never resort to guessing and why it is imperative that he always know his own limitations as well as those of the method he employs. It also indicates why certain negative findings can be as important as positive ones and should be carefully mentioned in the roentgen report.

It is at this point in the formulation of the report that correlation with clinical data should be carried out if the need arises. It must be remembered that the earlier one introduces clinical data into roentgen evaluation of the patient the greater is the chance of losing one of the method's chief virtues, objectivity.

Recommendation: The final requirement to be satisfied is to consider carefully the advisability of additional roentgenologic procedures and then to specify those which may be useful. A referring physician left with an equivocal opinion from the roentgenologist and given no advice as to how to procede further with roentgen studies may be led to believe that the method has nothing further to offer. Some physicians, being in a state of indecision, may request additional roentgen examinations that are costly, ill-advised, or even totally useless.

SUMMARY

The roentgenologist's responsibility to his medical colleagues and to patients must be reflected in the wording of the roentgen report. A complete report consists of an *evaluation* of the examination as to suitability for its stated purpose, thoroughness of execution, and technical quality. *Detection* must be accurate and complete. Every abnormality present, whether related to the main purpose of the examination or not, must be noted. A complete *description* in precise and informative terms follows. *Comparison* with any related films or reports is carried out. On the basis of the foregoing, plus pertinent clinical data if needed, a *diagnosis* is offered. This may be either specific in nature or one that relates the abnormality to a certain group of diseases or treatment category. Finally, a *recommendation* for additional films, special studies, or a comparison with other films completes the x-ray statement.

ROBERT S. SHERMAN, M.D.
Memorial Center
New York, N. Y.

ANNOUNCEMENTS AND BOOK REVIEWS

AMERICAN BOARD OF RADIOLOGY EXAMINATION FEE

The American Board of Radiology advises that, effective Jan. 1, 1961, applications for examination in Radiology, Diagnostic Roentgenology, or Therapeutic Radiology must be accompanied by a fee of $150. Re-examination and other fees will be raised in approximately the same proportion.

H. DABNEY KERR, M. D., *Secretary*

ASSOCIATION OF UNIVERSITY RADIOLOGISTS

Officers of the Association of University Radiologists for the current year are: President, Paul A. Riemenschneider, M.D., Syracuse, N. Y.; President-Elect, Robert D. Moseley, Jr., M.D., Chicago; Secretary-Treasurer, Melvin M. Figley, M.D., Department of Radiology, University of Washington, Seattle 5, Wash.

The association has recently established an annual Memorial Medal Award to be given in honor of deceased members to the resident in radiology writing the best original paper on some aspect of radiology during the period of competition. In addition to receiving the medal, the winner will be invited to present the paper at the annual meeting.

Contributions to be considered must be submitted by the first of January prior to the annual meeting, which is usually held in April or May. The paper must be the work of a single author, the resident.

Inquiries should be addressed and papers submitted to the Secretary, Melvin M. Figley, M.D., at the above address.

ARIZONA RADIOLOGICAL SOCIETY

The Arizona Radiological Society has elected the following officers for the ensuing year: President, Robert E. Flynn, M.D., Phoenix; Vice-President, Herbert D. Welsh, M.D., Tucson; Secretary-Treasurer, Don E. Matthiesen, M.D., 926 East McDowell Road, Phoenix; Councilor, James J. Riordan, M.D., Phoenix; Alternate Councilor, R. Lee Foster, M.D., Phoenix.

BROOKLYN RADIOLOGICAL SOCIETY

At a recent meeting of the Brooklyn Radiological Society, the following were elected to office: George A. Manfredonia, M.D., President; Isadore Katz, M.D., Vice-President; Joseph P. Arcomano, M.D., 168 Clinton St., Brooklyn 1, Secretary-Treasurer.

The Society meets monthly, on the first Thursday, October through May.

BUFFALO RADIOLOGICAL SOCIETY

At a recent meeting of the Buffalo Radiological Society, the following members were elected to office: President, Casimir G. Jenczeski, M.D.; Vice-President, Sawyer A. Glidden, M.D.; Secretary, Kenneth H. Seagrave, M.D., Buffalo Medical Group, 537 Delaware Ave., Buffalo 2; Treasurer, R. Joseph Naples, M.D.

IDAHO STATE RADIOLOGICAL SOCIETY

The following officers were elected at a recent meeting of the Idaho State Radiological Society, with the President, Dr. Donald D. McRoberts, of Lewiston, presiding: President-Elect, Paul B. Heuston, M.D., Twin Falls; Secretary-Treasurer, Claude W. Barrick, M.D., St. Alphonsus Hospital, Boise; Executive Committee member, Donald D. McRoberts, M.D. Meetings of the Society are held in the spring and fall.

MAINE RADIOLOGICAL SOCIETY

Newly elected officers of the Maine Radiological Society are: President, Francis J. O'Connor, M.D., Augusta; Vice-President, Edward C. Porter, M.D., Bangor; Secretary-Treasurer, Albert A. Poulin, M.D., Thayer Hospital, Waterville, Maine; Councilor, Jack Spencer, M.D., Portland; Alternate Councilor, Edward C. Porter, M.D.

OHIO STATE RADIOLOGICAL SOCIETY

At its recent annual meeting, the Ohio State Radiological Society elected the following to office: President, F. C. Curtzwiler, M.D., Toledo; President-Elect, James G. Tye, M.D., Dayton; Secretary, Paul D. Meyer, M.D., 6160 Cherry Hill Drive, Columbus; Treasurer, Delbert A. Russell, M.D., Elyria; Members of the Executive Committee, Frances A. Miller, M.D., Youngstown; John R. Hannan, M.D., Cleveland; Chapin Hawley, M.D., Cincinnati; C. J. Miller, Jr., M.D., Akron; Robert P. Ulrich, M.D., Toledo.

PENNSYLVANIA RADIOLOGICAL SOCIETY

The recently elected officers of the Pennsylvania Radiological Society are: President, Carl B. Lechner, M.D., Erie; President-Elect, Robert P. Barden, M.D., Philadelphia; First Vice-President, Peter E. Ringawa, M.D., Nanticoke; Second Vice-President, Lester M. J. Freedman, M.D., Pittsburgh; Secretary-Treasurer, Frederick R. Gilmore, M.D., Clearfield Hospital, Clearfield; Editor, John H. Harris, Jr., M.D., Carlisle; Associate Editor, Marlyn

W. Miller, M.D. Altoona; Councilor to American College of Radiology, John H. Harris, M.D., Harrisburg; Alternate Councilor, Newton Hornick, M.D., Pittsburgh.

SOCIETY FOR PEDIATRIC RADIOLOGY

There have recently been named to office by the Society for Pediatric Radiology: Frederic N. Silverman, M.D., Cincinnati, Ohio, President; John F. Holt, M.D., Ann Arbor, Mich., President-Elect; Richard G. Lester, M.D., 412 Union St., S. E., Minneapolis 14, Minn., Secretary-Treasurer.

COLÉGIO BRASILEIRO DE RADIOLOGIA

Newly elected officers of the Colégio Brasileiro de Radiologia are: Nicola C. Caminha, President; Nelson Carvalho, Vice-President; Camillo Segreto, General Secretary; Julio Pires Magalhães, First Secretary; Alvaro E. de Almeida Magalhães, Treasurer. The address of the Society is Avenida Angélica, 1170, São Paulo, Brazil.

SOCIEDAD DE RADIOLOGÍA, CANCEROLOGIA Y FÍSICA MÉDICA DEL URUGUAY

The Sociedad de Radiología, Cancerologia y Física Médica del Uruguay has elected the following officers: President, Dr. Luis A. Pieroni; Vice-President, Dr. Agustin Gorlero; Secretary-General, Dr. Ernesto H. Cibils; Secretary of the Proceedings, Dr. Alberto Villa; Treasurer, Dr. Enrique Capandeguy; Vocales, Dr. Helmut Kasdorf and Dr. Alvaro Ferrari. The address of the Society is Av. Agraciada 1464, Piso 13, Montevideo, Uruguay.

SOCIEDAD VENEZOLANA DE RADIOLOGÍA

At a recent meeting the Sociedad Venezolana de Radiología elected the following officers: Dr. Luis E. Gámez, President; Dr. Alfredo Mauri, Vice-President; Dr. Rubén Merenfeld, Secretary-General; Dr. Luis F. Muro, Treasurer; Dr. Abraham Haratz M., Secretary of the Proceedings; Dr. P. M. Itriago Sifontes and Dr. S. Núñez Mier y Terán, Vocales. The address of the Society is Apartado Postal 9362, Candelaria, Caracas, Venezuela.

AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE

The American Association of Physicists in Medicine has initiated a placement service for physicists and other allied scientists in the fields of medicine and biology. All individuals and organizations who are interested in making use of this service should address their inquiries to the Director of the Placement Service, Jack S. Krohmer, University of Texas Southwestern Medical School, Dallas, Texas.

NATIONAL BUREAU OF STANDARDS HIGH-INTENSITY ELECTRON ACCELERATOR

The National Bureau of Standards will install a high-energy, high-intensity linear electron accelerator (or *linac*) at its Gaithersburg (Md.) facility. The accelerator will increase the Bureau's ability to keep pace with the strides made by industry and the Armed Services in applying radiation to food sterilization, polymerization, and other uses. The increase in intensity is a necessary basis for the development of standards, measuring technics, and shielding requirements for this new field.

Letters to the Editor

To the Editor of Radiology

DEAR DR. DOUB:

What prompted Dr. Felson's recent letter[1] in defense of courses in x-ray diagnosis for general practitioners is not apparent. I recall no printed statements by radiologists against such instructional programs, provided they were properly constructed. Perhaps such statements have escaped attention.

I do believe however, that the defense he presents of such teaching is open to serious objection. His words should not be accepted as a statement of principles for radiologists to adhere to in discharging any responsibility they feel they may have in this area.

Since the Hippocratic oath and Principles of Medical Ethics were quoted in part, let us reaffirm what all physicians know. These guides are for the benefit of the patient not the profession. Hence, they define our duty as specialists in the medical practice of radiology as being primarily to patients and the public, and not to our colleagues should any conflict of interest arise between the two.

A number of years ago surgeons boldly accepted their responsibility and outspokenly supported improved surgical practices in the public interest, sometimes facing strong opposition from within the profession itself. Action of this kind is the manifest obligation of a medical specialty.

The practice of diagnostic roentgenology has now grown to a position of such importance medically that it, too, must be prepared to use its voice and prestige to insure adequate diagnostic service to all the people.

If an academic roentgenologist can satisfy this overriding responsibility to the public and at the same time offer general practitioners training courses of a few days or weeks duration while also advocating that our x-ray technicians spend two years in an approved school and our residents spend four years in training before becoming qualified, then so be it.

Dr. Felson's presentation failed to emphasize a fundamental concept in radiological teaching. It is

[1] Radiology **74**: 122, January 1960.

that there must be different teaching for the different professional groups. Residents and colleagues in radiology must be instructed how to carry out the actual practice of diagnostic roentgenology. Medical students and other nonradiologists, on the other hand, are best taught what the specialty has to offer for their patients, and how best to call on radiology to serve their needs.

In some countries the law does for the public what the specialities seek to do in the United States, *i.e.*, insure medical competence and expertness in all fields to all people. To practice outside one's medical field is forbidden legally.

If radiology will place the public interest foremost and act boldly in its behalf, and if it will make a clear distinction in its objectives and responsibilities between the teaching of radiologists and nonradiologists, it will enter into a future that can be better than its past or present.

Sincerely yours,
ROBERT S. SHERMAN, M.D.
Memorial Center, N. Y. C.

DEAR DR. DOUB:

Dr. Sherman's letter [see above] indicates that the main purpose of my original letter to you—to attain a better understanding of this issue within the profession—is being fulfilled. Dr. Sherman and I are not so far apart in our thinking as he implies. As a matter of fact, I do not disagree with *any* of the basic points of view he expresses.

He obviously does not object to instructional courses for general practitioners, provided they are "properly constructed." In my letter I, too, pointed out that content was the important factor. I indicated that such courses "should be directed primarily toward the teaching of medical subjects through the medium of roentgenology" and that they should make the nonradiologist "realize his inadequacy and encourage him to refer more patients to the roentgenologist." I also decried the performance of radiological examinations by the unqualified practitioner. Dr. Sherman's comparison with the time spent by the radiology resident and x-ray technician is apparently intended as ridicule, and he makes his obvious point. In order for us to teach nonradiologists what the specialty has to offer for their patients we must first have contact with them. This is the main purpose of lectures and courses, as I see it, since we have little occasion to do this individually.

I would like to call your readers' attention to Dr. Rigler's excellent editorial on *The Place of Radiology in Medical Education* in the April 1960 issue of RADIOLOGY. I share the points of view of both Dr. Sherman and Dr. Rigler and am grateful to you for helping to make it possible for all concerned to attain a mutual understanding.

Yours very truly,
BENJAMIN FELSON, M.D.
Cincinnati, Ohio

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

STUDIES IN RADIOTHERAPEUTICS. By J. S. MITCHELL, C.B.E., M.D., F.R.S., Regius Professor of Physic, University of Cambridge, Cambridge, England. A volume of 274 pages, with 57 figures. Published by Harvard University Press, Cambridge, Mass., 1960. Price $9.00.

GLOSSARY OF WORDS AND PHRASES USED IN RADIOLOGY AND NUCLEAR MEDICINE PREPARED FROM VARIOUS SOURCES FOR MEDICAL SECRETARIES, X-RAY TECHNICIANS, MEDICAL STUDENTS AND RESIDENTS IN RADIOLOGY. By LEWIS E. ETTER, B.S., M.D., F.A.C.R., Professor of Radiology and Chief, Radiological Service, Western Psychiatric Institute and Falk Clinic, School of Medicine, University of Pittsburgh; Consultant, Pittsburgh State Tuberculosis Hospital, Leech Farm, Pittsburgh, Penna. With a section on SUGGESTED TERMINOLOGY FOR ROENTGENOLOGICAL REPORTS. Devised by DOCTORS FISHER, BOYARD, AND BACON for the Pennsylvania Radiological Society. Foreword by Olive G. Johnson, A. B., Medical Record Librarian-in-Chief, Health Center, University of Pittsburgh. A volume of 204 pages, with 3 figures. Published by Charles C Thomas, Springfield, Ill., 1960. Price $8.50.

NEOPLASMS OF BONE AND RELATED CONDITIONS: ETIOLOGY, PATHOGENESIS, DIAGNOSIS, AND TREATMENT. By BRADLEY L. COLEY, M.D., Attending Surgeon (Emeritus). Bone Tumor Department, Memorial Hospital for Cancer and Allied Diseases, New York. A volume of 864 pages, with 649 illustrations and 31 tables. Published by Paul B. Hoeber, Inc., Medical Division of Harper & Brothers, New York 16, N. Y., 2d ed., 1960. Price $30.00.

RADIOLOGY AS A DIAGNOSTIC AID IN CLINICAL SURGERY. By HOWARD MIDDLEMISS, M.D., F.F.R., D.M.R.D., Director of Radiology, United Bristol Hospitals, Lecturer-in-Charge, Department of Radiodiagnosis, University of Bristol, Bristol, England. A volume of 152 pages, with 86 figures. Published by Charles C Thomas, Springfield, Ill., 1960. Price $7.50.

TUMORS OF CHILDHOOD: A CLINICAL TREATISE. By HAROLD W. DARGEON, M.D., Attending Pediatrician and Chief, Pediatric Service, Memorial Hospital for Cancer and Allied Diseases; Attending Pediatrician, St. Luke's Hospital;

Associate Professor of Clinical Pediatrics, Cornell University Medical College, New York, N. Y. A volume of 476 pages, with 315 figures. Published by Paul B. Hoeber, Inc., New York 16, N. Y., 1960. Price $20.00.

LEUKAEMIA: RESEARCH AND CLINICAL PRACTICE. By F. G. J. HAYHOE, M.A., M.D.(Cantab.), M.R.C.P.(Lond.), Lecturer in Medicine, University of Cambridge; Honorary Physician, The United Cambridge Hospitals. A volume of 336 pages, with 12 colored plates and 196 black-and-white illustrations. Published by Little, Brown & Co., Boston, Mass., 1960. Price $16.00.

REPORT OF THE COMMITTEE ON TRAINING IN RADIOLOGICAL HEALTH AND SAFETY TO THE AUTHORITY COMMITTEE ON HEALTH AND SAFETY, UNITED KINGDOM ATOMIC ENERGY AUTHORITY, FEBRUARY 1960. A pamphlet of 96 pages. Published by Her Majesty's Stationery Office, London, England, 1960. Agents in America: British Information Services, 45 Rockefeller Plaza, New York 20, N. Y. Price $1.04, postpaid.

KLINISCHE NEURORADIOLOGIE. Edited by PROF. DR. KURT DECKER, München. Co-Authors: K. DECKER, H. FISCHGOLD, V. H. MARK, D. L. MCRAE, J. METZGER, H. SCHUNK, J. M. TAVERAS, O. WIEDENMANN. A volume of 508 pages, with 1,428 illustrations on 550 figures. Published by Georg Thieme, Herdweg 63, (14a) Stuttgart, Germany, 1960. Distributed in the United States and Canada by Intercontinental Medical Book Corporation, New York 16, N. Y. Price DM 230.—($54.75).

RADIOLOGISCHE EXPLORATION DES BRONCHUS. By DR. S. DI RIENZO, a.o. Professor für Radiologie, Córdoba, Argentina, AND DR. H. H. WEBER, Facharzt für Radiologie, Bern, Switzerland. A volume of 282 pages, with 650 illustrations on 268 figures. Published by Georg Thieme, Herdweg 63, (14a) Stuttgart, Germany, 1960. Distributed in the United States and Canada by Intercontinental Medical Book Corporation, New York 16, N. Y. Price DM 54.—($12.85).

TUMEURS MALIGNES DU PHARYNX ET DU LARYNX: ÉTUDE ANATOMO-TOPOGRAPHIQUE ET RADIOGRAPHIQUE. By F. BACLESSE, Chef de service du radiodiagnostic et de la radiothérapie à la Fondation Curie (Institut du radium de l'Université de Paris), Chef de service de radiothérapie à l'Hôpital Américain. A volume of 770 pages, with 678 figures. Published by Masson & Cie, 120 Blvd. St.-Germain, Paris, 6e, France, 2d ed., 1960.

NEURORADIOLOGIE: RADIO-ANATOMIE NORMALE ET PATHOLOGIQUE DU CRÂNE. By A. WACKENHEIM, Ancien interne des Hôpitaux de Strasbourg, ancien chef de clinique neurologique, médicin-assistant E. R. des Hôpitaux de Strasbourg. A volume of 392 pages, with 122 figures. Published by G. Doin & Cie, 8, Place de l'Odéon, Paris, 6e, France, 1960. Price 38 NF.

BRONCOGRAFIA CON BÁRIO E METILCELULOSE: OBSERVAÇÕES NO HOMEM E ESTUDO EXPERIMENTAL. By DIRCEU RODRIGUES. Tese de concurso à docência livre de clínica propedéutica médica da Faculdade de medicina da Universidade do Paraná. A monograph of 94 pages, with 59 figures. Published by the author, Rua Almirante Conçalves, 1865, Curitiba, Paraná, Brazil, 1958.

Book Reviews

SAFE HANDLING OF RADIOACTIVE ISOTOPES IN MEDICAL PRACTICE. By EDITH H. QUIMBY, Sc.D., Professor of Radiology (Physics), College of Physicians and Surgeons, Columbia University, New York, N. Y. A monograph of 130 pages, with 17 figures. Published by The Macmillan Co., New York, 1960. Price $4.50.

A new book by Dr. Quimby is sure to be of interest to all those working in the radiological field. This small volume is designed for the nonexpert using radioactive materials—technicians, nurses, and doctors without special training in radiation—as an explanatory supplement to the rules of the radiation safety officer. Most of the material can be found elsewhere, but in widely scattered sources. The value of the book lies in the collecting of this information into one easily available source, in its clear and simple explanations, and especially in its practical applications to commonly met problems. Any institution using radioactive isotopes will want copies available for personnel in this field.

CANCER AND ALLIED DISEASES OF INFANCY AND CHILDHOOD. Edited by IRVING M. ARIEL, M.D., Associate Professor of Clinical Surgery, New York Medical College; Attending Surgeon, Hospital for Joint Diseases; Staff Surgeon, Long Island Jewish Hospital; Attending Surgeon, Pack Medical Group, New York, N. Y., AND GEORGE T. PACK, M.D., Associate Professor of Clinical Surgery, Cornell University Medical College; Attending Surgeon, Memorial Center for Cancer and Allied Diseases; Attending Surgeon, Pack Medical Group, New York, N. Y. With 27 Contributing Authors. A volume of 606 pages, with numerous figures and tables. Published by Little, Brown & Co., Boston, Mass., 1960. Price $22.50.

This book, the work of 27 authors, represents a thorough review of the tumors and tumor-like conditions of infancy and childhood.

The first chapter is general in nature, discussing the incidence, location, and pathogenesis of tumors

in children as compared to adults. There are two chapters on the general care of children under treatment for cancer and on preoperative and postoperative care. A rather short section on the principles of radiation is the only part of the book written by a radiologist, Ralph F. Phillips. The remaining chapters discuss tumors by location: the head and neck, the eye, breast, thorax, etc. There are separate chapters on Wilms' tumor, the teratoid tumors, and the reticuloendothelioses. A chapter on the lymphomas and leukemias contains an excellent discussion of chemotherapy.

The book is basically clinical in nature. In most sections the treatment of the child as a whole is stressed. For each tumor there are discussions of general management of the patient in view of the special problems presented by the particular tumor, a sketch of the pathology, and a good discussion of course, prognosis, and treatment. The various modes of therapy are discussed, and when differences of opinion exist as to the procedure of choice, as in Wilms' tumor, the different methods used are described and discussed.

The extensive bibliography is located at the end of the text rather than being divided and placed with the appropriate chapters, which makes it rather unwieldy. The book should be a valuable reference work for any physician concerned in the treatment of cancer in children.

ROENTGEN EXAMINATIONS IN ACUTE ABDOMINAL DISEASES. By J. FRIMANN-DAHL, M.D., Ph.D., Chief of Roentgen Department, Ullevål Hospital, Oslo, Norway. A volume of 518 pages, with 446 figures. Published by Charles C Thomas, Springfield, Ill., 2d ed., 1960. Price $15.50.

Professor Frimann-Dahl has rewritten and enlarged his previously well received work for a second edition. Several chapters and over 200 new illustrations have been added.

The normal abdominal picture and general pathological findings are first discussed, together with the roentgen changes which are of importance. The remaining text is devoted to specific pathological conditions, the roentgen findings being related to the clinical picture in a well co-ordinated manner.

This volume, with its well chosen illustrations, should be of great interest to radiologists as well as to surgeons and any others who deal with acute abdominal cases. The author's wide experience is evident throughout.

STRAHLENBIOLOGIE, STRAHLENTHERAPIE, NUKLEARMEDIZIN UND KREBSFORSCHUNG. Edited by H. R. SCHINZ, H. HOLTHUSEN, H. LANGENDORFF, B. RAJEWSKY, AND G. SCHUBERT. ERGEBNISSE 1952-1958. By G. BARTH ET AL. A volume of 998 pages, with 395 figures and 140 tables. Published by Georg Thieme, Herdweg 63, (14a) Stuttgart, Germany, 1959. Price DM 275.– ($65.50). Distributed in the United States and Canada by the Intercontinental Medical Book Corporation, New York 16, N. Y.

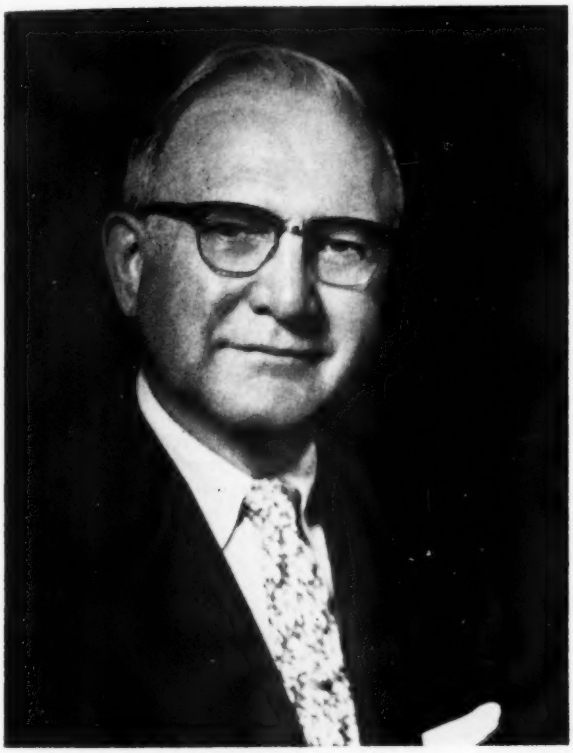
This volume presents a cross-section of the fields of radiation therapy, radiation biology, nuclear medicine, and cancer research. The authors have tried to give the essential, up-to-date results of research and clinical experience in fields which have developed enormously in recent years. The amount of information is of a magnitude seldom found in a single publication: yet, the careful presentation makes reading it a pleasure.

The work begins with a modern presentation of the target theory, which is followed by articles on the genetic effects of radiation upon bacteriophages, microorganisms, *Drosophila*, and mammals. Because of the importance of dose measurements in radiation applications, the chapter on dosimetry, illustrating different technics, will be appreciated by many readers. A chapter devoted to the physics and technics of megavolt irradiation gives an excellent survey of different high-energy accelerators, as well as dosimetric problems in connection with high-energy radiation.

Another essay gives the clinical experiences derived in Zurich with the Betatron, including intravesicular applications of cobalt-60 in bladder tumors. Also discussed are Electron Therapy by Supervoltage Generators, Methods, Comparisons and Results of Movement and Sieve Irradiation, Acute General Reactions in Whole-Body and Partial-body Irradiation, Radiation Therapy of Bronchial Carcinoma, Critical Survey of Treatment with Artificial Radioactive Isotopes, Clinical Diagnosis of Thyroid Diseases, Drug Effects and General Radiation Damage, and Radiomimetic Materials.

All sections, including the extensive bibliography, are excellent. Everyone concerned with the biological effects of radiation will profit from the concentrated presentation of the essential facts as they are known at the present time. To H. R. Schinz, the dynamic and indefatigable senior editor, as well as the other editors and contributors, congratulations on this useful publication.

IN MEMORIAM



HORACE C. JONES, M.D.
1898–1960

In the death of Dr. Horace C. Jones, American radiology, and Michigan radiology in particular, suffered a real loss. His death occurred on April 20, 1960, in Grand Rapids, Mich., after an illness of three months.

Dr. Jones was born in Arkansas in 1898, and was graduated from the University of Arkansas and subsequently from the Medical School of that institution, receiving his M.D. in 1928. Following a two-year internship in St. Vincent's Infirmary in Little Rock, he served a residency in radiology at the Henry Ford Hospital in Detroit, where he later became associate radiologist. After four years of service in the naval medical corps during World War II, much of which was on a hospital ship in the Pacific and Far East, he was retired with the rank of captain and returned to his former post at the Henry Ford Hospital. He remained there until 1946, when he became head of the X-Ray Department of the Blodgett Memorial Hospital in Grand Rapids. He served with distinction in this capacity during the remaining years of his life.

Dr. Jones was a skilled clinician, with a kindly and sympathetic attitude. This was apparent especially in his care of therapy patients, who quickly sensed this welcome attribute. For many years he was my respected colleague, and for thirty years my close friend.

Dr. Jones was a Fellow of the American College of Radiology and of the American Medical Association. He was a member of the Radiological Society of North America, the American Roentgen Ray Society, and the Detroit X-ray and Radium Society, of which he was a past president. He was also a Fellow of the Academy of International Medicine. He was a faithful and influential member of the Calvary Baptist Church of Grand Rapids, and at the time of his death was Chairman of the Board of Deacons. He was also a past president of the Baptist Theological Seminary, Grand Rapids.

Dr. Jones is survived by his wife, Elizabeth, a son, William, and a daughter, Mrs. Jack De Ward. To them we extend our sympathy.

HOWARD P. DOUB, M.D.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

An Arteriographic Study of Cerebrovascular Disease. Fletcher H. McDowell, Robert W. Schick, William Frederick, and Howard S. Dunbar. Arch. Neurol. **1:** 435–442, October 1959. (Bellevue Hospital, New York, N. Y.)

In a study of 68 patients with 69 separate episodes of clinical stroke, the authors sought to evaluate the information to be gained and the risk involved in intracranial arteriography in this condition. Carotid angiography was performed, usually percutaneously, and in 6 cases vertebral angiography was done in addition, also with percutaneous puncture. A local anesthetic was commonly used, but uncooperative patients were given general anesthesia. The contrast medium was 35 per cent Diodrast except in 2 cases in which 50 per cent Hypaque was employed. Not more than 10 ml. of the agent was introduced at a single injection.

The middle cerebral artery was found to be occluded more frequently than any other artery. The next most common occlusion was in the internal carotid artery, usually at or near its origin. Anterior cerebral artery occlusion and vertebrobasilar occlusion each occurred once in the series. Three cases of intracerebral hematoma were found, but arteriography did not distinguish intracerebral hemorrhage from cerebral thrombosis when the clinical examination did not make this distinction. Two of the patients had a subdural hematoma and one a tumor, indicating that clinical diagnosis of stroke may be inaccurate.

The authors believe that angiography is not helpful in a typical case of stroke, but in patients with inadequate or no available history, this study may aid in eliminating the possibilities of subdural hematoma, intracerebral hematoma, and brain tumor.

The incidence of local complications associated with arterial puncture is no different for patients with cerebrovascular disease than for any other group. Fourteen of the patients in this series, after arteriography, showed an increase in the severity of their hemiplegia or a decrease in the level of consciousness, or died. Complications appeared to be clearly related to the clinical state at the time of arteriography. The risk is high if the patient is in a coma or stupor or if the clinical condition is worsening.

Six roentgenograms; 5 tables.

GORDON L. BARTEK, M.D.
Grand Rapids, Mich.

Modern Concepts Concerning Etiology and Treatment of Cerebrovascular Accidents. Robert A. Kuhn. Angiology **10:** 342–354, October 1959. (25 Franklin St., Morristown, N.J.)

Concepts of factors operative in the production of strokes have undergone marked evolution during the past several years, and treatment has been revised accordingly. Safe cervical-cerebral angiography has played a large part in bringing about these changes, for it is through increasing use of this procedure that accurate evaluation of the cerebrovascular system has been made possible, and a focal anatomical diagnosis the rule.

Segmental arterial disease in the neck is now recognized as an important cause of hemiplegia. Surgical restoration of blood flow through or around vertebral artery and carotid artery occlusions may, in selected cases, cure the patient with stroke or prevent further attacks, whereas anticoagulant medication has been found beneficial for many of those with proved cerebral artery occlusions.

Clinical neurologic evaluation of the patient with cerebrovascular disease may point with considerable accuracy to the zone or zones of cerebral dysfunction, but often may fail to indicate the precise location of the lesion responsible for such dysfunction. A variety of different distant lesions may, unfortunately, produce the same neurologic signs and symptoms.

The author holds that the clinical syndrome known as stroke is a symptom complex representing cerebral dysfunction, being dependent upon a number of complex variables in cervical-cerebral circulatory structure and function. These vascular unknowns are best investigated with serial cervical-cerebral angiography. In many instances accurate diagnosis is possible only by this means.

Six cases chosen at random from protocols of a series of stroke victims are reported in detail to illustrate some of the clinical surprises encountered with complete investigation of patients suffering supposedly "ordinary" strokes.

Eleven roentgenograms.

Surgical Treatment of Atherosclerotic Occlusive Lesions in Patients with Cerebral Arterial Insufficiency. E. Stanley Crawford, Michael E. De Bakey, William S. Fields, Denton A. Cooley, and George C. Morris, Jr. Circulation **20:** 168–180, August 1959. (Baylor University College of Medicine, Houston, Texas)

Patients with symptoms of cerebral arterial insufficiency should have the benefit of arteriography, since many cases with an atheromatous process limited to the external portions of the vessels are amenable to surgery. If the occlusion extends to the intracranial portion of the vessel, nothing can be done. Partial occlusions are treated by endarterectomy while more extensive occlusion requires a bypass graft of the synthetic material. Experience has shown that the disease is progressive, with partial occlusions becoming complete, and complete occlusions showing a tendency to extension.

The authors performed arteriography in 174 consecutive patients with clinical manifestations of ischemia of the brain or upper extremity and demonstrated extracranial arterial occlusion in 73, of whom 63 (with 115 extracranial arterial occlusive lesions) underwent operation. Bilateral percutaneous carotid arteriography was performed in all patients with cerebral arterial insufficiency in the regions of the anterior and middle cerebral arteries who did not have signs associated with lesions in the great vessels arising on the aortic arch (these were studied by angioaortography). Incomplete occlusions of the internal carotid appeared as defects in the outline of the vessel near its origin. When occlusion was complete, the extracranial segment was not visible on the roentgenogram. All patients with incomplete occlusions were regarded as operable, but with complete occlusion surgery was considered only when the symptoms suggested a very recent onset.

Bilateral vertebral angiography was done in all patients with clinical manifestations of basilar artery insufficiency. Patients in this group with partial oc-

clusions are considered excellent candidates for operation. Complete occlusion is regarded as inoperable unless a patent distal segment is present or the occlusion is recent.

All patients with lesions of the great vessels arising from the aortic arch were completely relieved and the majority of patients with lesions of the internal carotid and the vertebral arteries were either relieved or significantly improved by operation.

Eleven roentgenograms; 2 photomicrographs; 1 photograph; 1 drawing; 1 table.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Hypaque in Cerebral Angiography. Report of Complications in 617 Angiograms. Samuel J. Brendler and George J. Hayes. J. Neurosurg. **16:** 454–460, July 1959. (S. J. B., 171 Harrison Ave., Boston 11, Mass.)

This report is based on 617 intracranial angiograms, 561 by way of the carotid and 56 by a vertebral artery. For the purposes of the study, an intracranial angiogram is defined as a single session in which the patient undergoes one or more injections of 50 per cent Hypaque into one carotid artery (common or internal) or into one vertebral artery. The following factors were recorded for each angiogram: (1) volume of each injection (average 8 c.c.); (2) total volume per complete angiogram (average 33 c.c.); (3) injection interval (average 6.5 minutes); (4) duration of patient-sessions (thirty minutes to two hours). General anesthesia was used on only 34 occasions. Patients ranged in age from eighteen months to fifty-three years.

In this series, there were no deaths and no permanent neurological sequelae. All complications were transient. There were 2 instances of hemiparesis, 16 of seizures, and 1 each of severe headache and subjective impending syncope. Careful analysis of the collected data failed to reveal definite causes for the complications. Patient age, technic of injection, and type of anesthesia were apparently without influence. In the absence of any specific clues, the authors recommend (1) proper selection of patients—those without significant cerebral atherosclerosis or hypertension—and (2) careful angiographic technic.

Two tables.

SAMUEL B. HAVESON, M.D.
Lynwood, Calif.

Arteriographic Demonstration of the Vertebral Artery with Special Reference to Percutaneous Subclavian Puncture. Leon Morris. Brit. J. Radiol. **32:** 673–679, October 1959. (Brook Hospital, Shooters Hill Road, London, S. E. 18, England)

Arteriographic demonstration of the vertebral artery and its branches may be achieved by a variety of methods. An assessment of these methods is made under two headings: Demonstration of the Vertebral Artery in the Neck and Demonstration of the Intracranial Branches of the Vertebral Artery.

For both purposes the author prefers retrograde percutaneous subclavian artery injection. The vessel is punctured with an ordinary carotid needle in a retrograde fashion with the needle directed medially and downward, and 10 ml. of 45 per cent Hypaque is injected as rapidly as possible. The exposure is made just before the end of the injection for the films of the neck. For films of the intracranial course of the vessel the first exposure is made immediately after the end of the injection. Occlusion of the axillary artery has not been found necessary. Injection of only one side is undertaken at an examination, and a chest film is always obtained before the patient leaves the department to exclude the possibility of pneumothorax.

The vertebral artery in the neck may also be shown by retrograde brachial catheterization, but direct subclavian puncture is technically easier. It avoids traversing of the tortuous subclavian artery, the possibility of hematoma at the puncture site, and the known complication of arteriovenous fistula formation at the puncture site in the brachial artery. Percutaneous femoral catheterization can give good results but placement of the catheter may be difficult and a larger amount of medium is needed than after direct subclavian puncture.

For demonstration of the intracranial branches of the vertebral artery, subclavian puncture is no more difficult than direct vertebral artery puncture and can produce comparable results. It avoids the problems of spasm and trauma to the vertebral artery, and may be useful when the direct approach has failed and in patients with established atherosclerosis, those who have had thrombotic episodes, and possibly, even more generally, in the older age groups with their liability to degenerative vascular disease.

Seventeen roentgenograms.

R. P. STORRS, M.D.
Los Angeles, Calif.

Intracavernous Aneurysms of the Internal Carotid Artery: Their Clinical Features and Natural History. S. P. Meadows. Arch. Ophth. **62:** 566–574, October 1959. (142 Harley St., London, W. 1, England)

Aneurysms arising from the internal carotid artery as it traverses the cavernous sinus behave differently from aneurysms arising elsewhere in the skull, by virtue of their position. Fifteen cases of unruptured intracavernous aneurysm, followed for some years, are reported. All but 2 of the patients were women, and all except 4 were over the age of fifty when symptoms first appeared; only 1 patient was under forty.

While the onset of symptoms in unruptured intracavernous aneurysm is occasionally abrupt, it may be slow and insidious. Pain may be a prominent symptom or relatively minor. Ocular palsy is a presenting clinical sign and usually there is eventual involvement of the third nerve. Trigeminal sensory loss occurs, but in a third of the author's series there was no evidence of such loss eight to twelve years after onset of symptoms. Unilateral exophthalmos, present in 9 cases in this series, is usually a fairly late phenomenon and moderate in degree. Compression of the optic nerve by anterior expansion of the aneurysm, causing progressive loss of vision of the ipsilateral eye followed by optic atrophy, occurred in 6 patients. Three had ipsilateral and 3 bilateral deafness. Only 2 of the 15 patients had a cephalic murmur; the bruit ceased after carotid arteriography in 1 patient and after common carotid ligation in the other. About half of the series had vascular hypertension and this, together with atherosclerosis, is probably one factor in pathogenesis.

Careful roentgen examination of the skull and optic foramina may contribute materially to the diagnosis. As the aneurysm extends in all directions, special attention should be paid to the optic foramina and superior orbital (sphenoidal) fissure, the sella, the petrous portion of the temporal bone, and the floor of the middle fossa. Calcification develops gradually in the walls of the aneurysm, probably over a period of several years. It is seen as an intermittent or continuous curvilinear

deposit above and lateral to the sella; it may finally form a complete or incomplete circle, with the sella showing through in the center in the lateral view. Calcification was demonstrable in 8 of the 15 cases; in 5 of these it was not evident in early roentgenograms, becoming visible between four and seven years after the onset of symptoms.

Erosion of the lower and outer rim of the sphenoidal fissure is a particularly common feature of intracavernous aneurysm, due to anterior expansion of the wall. It was found in 8 of the 15 cases, usually in association with exophthalmos or compression of the optic nerve, or both. Further erosion may cause widening of the superior orbital fissure, which seems to coalesce with the optic foramen. Destructive changes are sometimes seen in the sella itself, which may be enlarged, with erosion of the anterior clinoid process and of the dorsum sella. Erosion of the floor of the middle fossa occurred in 1 patient, and erosion of the petrous part of the temporal bone in another.

Percutaneous arteriography was performed in 13 of the 15 patients. In 12, the aneurysm filled and was usually relatively large, often obliterating the outline of the sella in the lateral view; in 1 patient the radiopaque shadow was notably smaller than the calcified ring shadow, indicating a considerable layer of clot in the wall. One calcified aneurysm failed to fill; radiopaque material revealed a block of the internal carotid artery shortly above the carotid bifurcation, and it seems likely that in this patient, with a history going back about seventeen years, spontaneous cure had taken place by thrombosis in the aneurysm and internal carotid.

Fourteen cases were followed. Six patients were still alive and well at the time of the report, apart from an ocular palsy or loss of vision, eight to eleven years after the onset of symptoms; only 1 of these had severe hypertension (240/140). There had been 7 deaths, five to twenty years after the appearance of symptoms, chiefly from cardiac failure or cerebrovascular accidents. Most of these patients had vascular hypertension. One patient was still alive with hemiplegia, which followed internal carotid ligation performed eighteen months after onset of symptoms.

Five roentgenograms; 5 photographs.

Aneurysm of the Vein of Galen. J. L. G. Thomson. Brit. J. Radiol. **32**: 680–684, October 1959. (Frenchay Hospital, Bristol, England)

The author reports what he believes to be the fifteenth case of aneurysm of the vein of Galen to appear in the literature. The cases previously described are reviewed briefly with special attention to the radiographic features, on which the diagnosis to a large extent depends.

Clinically, the present case was similar to the others, with dilated veins over the scalp, forehead, and around the eyes. A convergent squint was present, evidently due to midbrain pressure. Some patients have also shown dysarthria, dysphagia, and dyspnea from pressure on the bulb.

Radiographically, the present case also showed the usual findings. Plain films of the skull may be normal, or there may be signs of increased intracranial pressures. In patients over fifteen years, characteristic curvilinear calcification is seen in the wall of the aneurysm, sometimes measuring up to several centimeters in diameter. Air studies may be normal, or may show dilatation of the third and lateral ventricles with the fourth ventricle normal in size. On cerebral angiography a large central pool of medium may be seen on films made during the post-arterial phase. This is the most significant finding. There may also be enlargement of a supplying vessel, usually the posterior cerebral artery. Other venous anomalies may also be noted.

Five roentgenograms; 1 photograph; 1 table.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Roentgen Diagnosis of Acoustic Neurinoma. W. Schlungbaum. Radiol. clin. **28**: 139–149, May 1959. (In German) (Strahleninstitut der Freien Universität, Berlin-Charlottenburg 2, Germany)

The findings in 66 patients with acoustic neurinoma are reported. In only 17 per cent of these tumors are no roentgenologic changes to be found. In 62 per cent of the author's cases erosion of the petrous bone was demonstrable. In 47 per cent there was enlargement of the internal auditory meatus. Only rarely was this latter finding observed without destructive changes in the petrous bone. Occasionally, contralateral changes are present (in 19.7 per cent of the author's cases).

The Stenvers position is recommended for demonstration of roentgen changes. Tomography may be helpful.

The importance of careful neurological examination is stressed for early diagnosis and successful therapy.

Eleven roentgenograms; 2 diagrams; 1 table.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

Glossopharyngeal Neuralgia and Ossification of the Stylohyoid Ligament. Carl J. Graf. J. Neurosurg. 16: 448–453, July 1959. (Buffalo General Hospital, Buffalo, N. Y.)

Ossification of the stylohyoid ligament was observed roentgenographically in a patient with glossopharyngeal tic precipitated by swallowing and turning of the head to the side of the ossified ligament. Painful paroxysms were also induced by mild pressure applied to the lateral aspect of the hyoid bone. Removal of the ossified ligament resulted in relief of pain. One other patient with glossopharyngeal tic and ossification of the stylohyoid ligament was relieved in the same way.

Records of 12 cases of glossopharyngeal neuralgia were reviewed. Six of the patients had ossification of the stylohyoid ligament on the affected side (including the 2 mentioned above); 3 could not be reexamined, and it is not known whether the stylohyoid ligament was ossified in these cases. The high incidence of ossification of the ligament in this series suggests that glossopharyngeal tic may be due to mechanical injury to the nerve because of its close proximity to the ligament, though the spontaneous relief of pain sometimes observed is difficult to explain on this basis. Roentgen examination of the necks of all patients with glossopharyngeal neuralgia may help in evaluation of the etiology.

One roentgenogram; 1 drawing.

SAMUEL B. HAVESON, M.D.
Lynwood, Calif.

Some Congenital Cysts and Fistulæ of the Neck. T. Philp. J. Fac. Radiologists **10**: 186–196, October 1959. (Royal Infirmary, Edinburgh, Scotland)

The author discusses congenital cysts and fistulas occurring in the neck and stresses the value of radio-

graphic examination with contrast media in determining their extent prior to operation.

These anomalies may be classified into two categories: (1) those appearing in the midline; (2) those arising in the lateral aspect of the neck. The midline group is made up solely of thyroglossal cysts or sinuses, following incomplete obliteration of the thyroglossal duct during fetal development. The remaining cysts, sinuses, and fistulas are found in the lateral aspect of the neck, the commonest of these being the branchial or lateral cervical cyst or sinus. Solitary lymphatic cysts confined to the neck are rare; they are more commonly found in infants, extending into the superior mediastinum. Small cysts and sinuses around the ear, resulting from anomalies of the first branchial arch and the developing pinna, are also rare, and none is included in the present series.

Case histories and roentgenograms demonstrating the various types of cysts are presented.

Nineteen roentgenograms; 1 photograph; 3 diagrams.

THEODORE E. KEATS, M.D.
University of Missouri

THE CHEST

Differential Diagnosis in Unilaterally Increased Transparency of the Lungs, Caused by Congenital Defects of the Major Pectoral Muscle. R. Walther and B. Blaschke. Fortschr. a. d. Geb. d. Röntgenstrahlen 91: 488–493, October 1959. (In German) (Landesschirmbildstelle Hannover, Germany)

Congenital defects of the major pectoral muscle were described by Froriep in 1839. The most common defect is said to be a combined lack of the sternocostal portion of the major pectoral muscle and of the minor pectoral muscle. This is followed in frequency by absence of both the major and minor pectoral muscles. In males the frequency of pectoral muscle defects is 1 : 4000. The condition is less often encountered in females.

The authors describe 13 cases (12 in males). In 5 cases a total defect of the major pectoral muscle was present and in 8 cases the defect was partial. Associated defects in the development of the muscles in the arm on the ipsilateral side were present in 2 cases and changes in the thoracic cage in 1 case. In all the patients there was atrophy of the skin and absence of hair on the same side as the muscular defect. No hereditary aspect could be demonstrated.

The extent of the increased transparency of the chest depends upon the type of muscular defect. When the sternocostal portion of the major pectoral muscle is lacking the transparency is limited to the lower part of the chest. The anterior axillary fold is seen as an increased density in the upper part, representing the clavicular portion of the major pectoral muscle. In cases with complete defect, the anterior axillary fold is not present. The shadow of the arm, which normally is hidden by the anterior axillary fold is well seen.

The differentiation from other conditions with unilaterally increased transparency of the lung is usually easy. The authors mention density variations of the thoracic muscles, unilateral pleural thickening, hypoplasia of the pulmonary vessels, emphysema, and pneumothorax as possibilities to be considered in the differential diagnosis.

Three roentgenograms; 3 photographs; 1 drawing.

ERIK CARLSSON, M.D.
St. Louis, Mo.

Spontaneous Pneumothorax in Apparently Healthy Flying Personnel. George Dermksian and Lawrence E. Lamb. Ann. Int. Med. **51**: 39–51, July 1959. (Randolph AFB, Texas)

Spontaneous pneumothorax at ground level in apparently healthy individuals is relatively innocuous and has a benign course, unless complicated by massive collapse of the involved lung, or the development of a tension pneumothorax or hemopneumothorax. In flying personnel, however, the problem is more serious, due to additional hazards and risks imposed by altitude: First, an increased frequency of initial pneumothorax due to recurrent exposure to altitude can occur. Second, if the spontaneous pneumothorax should occur at altitude, the problem of hypoxia is greatly magnified.

Twenty-five persons from flying personnel with no apparent disorder other than a previous pneumothorax were selected for study. These had experienced 38 episodes of pneumothorax. Detailed histories, complete physical examinations, laboratory studies, and electrocardiograms were obtained, pulmonary function tests were done, and a variety of roentgenographic technics were employed, including routine postero-anterior and lateral chest films, apical lordotic views, and apical laminagrams. In 11 of the cases, additional anteroposterior films were taken in the altitude chamber, at simulated altitudes of 10,000, 20,000, 30,000, 40,000, and 43,000 feet with pressure breathing.

Of the 25 persons, only 3 (12 per cent) had had their episodes of spontaneous pneumothorax while in flight. These had had a total of 11 pneumothoraces, all at altitude, either in an aircraft or in the altitude chamber. These 11 pneumothoraces constituted 29 per cent of the total number of episodes. Thirty-seven per cent of the episodes occurred at rest. Twenty-three per cent were associated with some type of physical activity, and 8 per cent were preceded by a paroxysm of coughing.

Following re-expansion of the involved lung, pulmonary function tests of ventilation were within normal limits in all 25 cases. The routine chest films disclosed pathologic entities (cysts, emphysematous bullae, or pleural blebs) which would account for the spontaneous pneumothorax in 7 of the cases (28 per cent). In an additional 7, apical laminagraphy revealed the pathologic etiology. In 11 cases, x-ray studies were performed in the altitude chamber. In 6 of these cases, where the routine roentgenograms were unremarkable, the chamber films were of no additional help.

The etiology of spontaneous pneumothorax in the apparently healthy individual still remains in some doubt, due to inability to demonstrate abnormalities clinically in all cases. There are four pathologic entities to be considered: pleural adhesions, congenital cysts of the lung, a scar tissue vesicle, and an emphysematous valve vesicle.

This small series of cases tends to confirm the impression that all cases of spontaneous pneumothorax have some basic underlying pathology. By far the most frequent pathologic finding with roentgenographic technics was air-containing vesicles and cysts. In every case where the vesicles or cysts were exposed to increasing altitudes, it was of interest to note their expansion with progressive decrease in atmospheric pressure.

Five patients in this series were operated upon; in 4 the pathologic specimens revealed emphysematous vesicles and in 1 congenital cystic disease.

One table.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

The Relation of Antecedent Tuberculosis to Bronchogenic Carcinoma. A Study of the Tuberculin Test, Radiologic and Pathologic Evidence. E. C. Meyer, J. H. Scatliff, and G. E. Lindskog. J. Thoracic & Cardiovas. Surg. **38:** 384–397, September 1959. (Yale University School of Medicine, New Haven, Conn.)

In an investigation of a possible connection between bronchogenic carcinoma and pulmonary tuberculosis, a series of 100 patients with bronchogenic carcinoma was compared with a control group with respect to the tuberculin skin test. This same group was studied radiologically to determine how often the calcified, primary tuberculous complex was associated anatomically with tumor; and both lesions were classified as to segmental location.

I. *Tuberculin Studies:* The case histories of 100 consecutive patients with bronchogenic carcinoma in whom tuberculin skin tests had been recorded were reviewed. Tuberculin skin tests, using purified protein derivative, were given to 100 males in the same general age group as those with bronchogenic carcinoma. Ninety-five per cent of those with carcinoma were tuberculin positive as compared to 80 per cent in the control group. This difference has statistical significance in the order $p < 0.01$. There was a greater correlation between bronchogenic carcinoma and the positive tuberculin reaction than with cigarette smoking. Eighty-six per cent of the carcinoma group and 77 per cent of the control group were smokers.

There were 50 epidermoid, 24 anaplastic, 15 adeno-, and 2 bronchiolar carcinomas. Nine cancers had no definite tissue-type diagnosis; 7 of these were inoperable and 2 had negative biopsies on exploration. The subsequent lethal course, however, favored the diagnosis of bronchogenic carcinoma.

II. *Radiologic Studies:* Chest roentgenograms were available in all the carcinoma-tuberculin test group. In most instances, these included planigrams as well as standard views. Primary tuberculous foci were defined as isolated or multiple areas of discrete calcification in the lung fields, with or without hilar calcification. The latter when seen alone was considered part of the primary complex. Secondary tuberculous infection was identified as unilateral or bilateral, fibrous or fibrocalcific densities localized to the upper lung fields, under the supposition that 90 per cent of re-infection tuberculosis occurs in the apices.

Primary tuberculous foci were seen radiologically in 47 per cent of the series. Complete Ghon complexes were demonstrable in only 7 cases, hilar calcification alone in 23 cases, and parenchymal foci without demonstrable hilar components in 15. In 2 cases there were disseminated foci.

In 15 of the 100 cases there was definite radiologic evidence of re-infection tuberculosis, all in the upper lobes. In an additional 3 cases, there was questionable tuberculous re-infection. There were 13 cases of tuberculosis in the right upper lobe and 2 in the left upper lobe. Seven of the 15 tumors in this group were in the apical upper-lobe segments. Two tumors were in the superior lower-lobe segments.

In only 10 of the 100 cases could an anatomic-radiologic association of tumor and tuberculous lesion be established.

III. *Pathologic Studies of Resected Specimens in the Carcinoma-Tuberculin Test Group:* Re-examination of 33 specimens from the carcinoma-tuberculin test group gave additional evidence of tuberculosis beyond that accumulated by radiography. In 8 cases, 9 types of lesions, not established radiologically, were discovered. Included were 2 instances of re-infection tuberculosis associated with the tumors. Both patients had had re-infection tuberculosis diagnosed radiologically but on the side opposite the tumor. Another patient had a peripheral, hyalinized scar related to the tumor, and a fourth had a calcified node associated with a hilar tumor. Adding these 4 cases of pathologically associated tuberculosis and carcinoma to the 10 diagnosed radiologically brings the total to 14 for the entire series.

The segmental distribution of bronchogenic carcinoma was tabulated on radiologic examination of 67 of the 100 cases, on gross examination of 33 resected specimens of the same series, and 142 unrelated, additional specimens. A predilection of tumors for the upper lobe and superior lower lobe segments was noted. The upper lobe segments were all involved, and with equal frequency.

Segmental placement of tumors by radiologic means may be misleading with certain peripheral neoplasms having extensions to major bronchi. In such instances, associated atelectasis and pneumonitis may mask the actual position of the tumor.

IV. *Pathologic Study of 50 Unrelated Surgically Resected Bronchogenic Carcinomas:* A macro- and micropathologic study of 50 additional resected specimens was undertaken to investigate further the incidence of associated pulmonary tuberculosis and bronchogenic carcinoma. Five types of tuberculous lesions were found in 25 cases. There were 7 instances of positively associated tuberculosis and bronchogenic carcinoma.

From the results of the authors' investigation and those of others, one cannot conclude that bronchogenic carcinoma and pulmonary tuberculosis are related etiologically. Even though both may at times affect the same portions of the lung, and the incidence of positive tuberculin reactors is extremely high, the lack of pathologic proof in a majority makes the assumption as yet invalid.

It seems reasonable to consider bronchogenic carcinoma as an abnormal process of epithelial regeneration in the lung. As with simple inflammation, it may have a variety of etiologic agents. Recent studies of "lung-scar cancers" seem to support the theory that it is the scar, and only remotely the agent causing the scar, that is important in the pathogenesis of the disease. Tuberculosis is a common cause of pulmonary scars. The most frequent location of bronchogenic carcinoma in the upper lobes and the apical segment of the lower lobes suggests a relationship to *re-infection* tuberculosis. Against this, however, are the facts that (1) only 15 per cent of the cases in the carcinoma-tuberculin test group had demonstrable coexistent re-infection tuberculosis, (2) only half of these had a positive anatomic association of both diseases, and (3) the anterior upper lobe segment (B^3), which was a common site of carcinoma, was less commonly the seat of re-infection tuberculosis.

Eleven tables.

Bronchogenic Cysts in Patients Presumed to Have Pulmonary Tuberculosis. Neil C. Andrews, Philip C. Pratt, and A. J. Christoforidis. Dis. of Chest **36:** 353–360, October 1959. (Ohio State University Health Center, Columbus, Ohio)

Two hundred and twenty-five pulmonary resections were performed at the Ohio Tuberculosis Hospital in two years, usually because of radiographic evidence of residual tuberculous cavity. Pathologic examination

showed that the cavitary lesions in 14 (6.2 per cent) were bronchogenic cysts rather than of tuberculous origin. All of the 14 patients had symptoms compatible with pulmonary tuberculosis but only 3 had active tuberculosis according to sputum examination and pathologic study.

The diagnosis of bronchogenic cyst was made only if the wall of the cavity showed ciliated columnar epithelium on a distinct basement membrane, plus smooth muscle, mucous glands, or cartilage. These findings served for differentiation from tuberculous cavities with fibrous walls or re-epithelialized walls without basement membranes.

Radiographically, most of the patients showed a cavity and pulmonary infiltration in one of the upper lobes. The infiltration cleared unusually rapidly after institution of antibiotic therapy, leaving a thin-walled cavity which changed little in size. Laminagrams frequently revealed multiple cavities in contrast to the single cavity more often seen on plain films. The bronchogram was characteristic, showing easy filling of the cyst by several rather large bronchial communications; tuberculous cavities rarely fill and practically never have multiple bronchial communications.

Eight roentgenograms; 2 photomicrographs; 1 photograph.

GARTH R. DREWRY, M.D.
Tampa, Fla.

Functional Stenosis Due to Bronchial Angulation. C. H. Nicholson, J. B. Perkins, E. B. Emerson, Jr., and G. L. Emerson. J. Thoracic & Cardiovas. Surg. **38:** 90–92, July 1959. (VA Hospital, Batavia, N. Y.)

In the patient with pulmonary tuberculosis, a destroyed, contracted left upper lobe may be associated with sufficient angulation of the lower lobe bronchus to cause functional stenosis. This is easily confused endoscopically with the anatomic stenosis produced by intrinsic bronchial disease. Recognition of this condition may allow conservation of pulmonary tissue at operation. Four such cases are reported. The characteristic bronchographic finding in these cases was a left main bronchus which curved outward and then upward, leading directly into the upper lobe orifice rather than the lower. The lower lobe took off from this upward curve in a sharply posterior and downward direction, producing marked angulation. Tuberculous bronchiectasis was present in the upper lobe in each case, and in the superior segment in one. No significant basilar bronchiectasis due to poor drainage was evident. Serial tomograms showed that the bronchial deformity was not present during the acute stage of the disease but developed as the destroyed left upper lobe contracted.

During the two-to-four year period following surgical treatment, x-ray studies have shown a stable lung and no positive cultures have been obtained. Results are considered good for control of the tuberculosis. Recent bronchograms of 3 patients revealed partial correction of the functional stenosis and no evidence of basilar bronchiectasis. In 1 patient cylindrical stenosis of the lower lobe bronchus has developed.

Four roentgenograms.

Acute Pneumococcal Lobar Pneumonia: The Significance of Non-Segmental Distribution. Robert G. Fraser and George Wortzman. J. Canad. A. Radiologists **10:** 37–46, September 1959. (Royal Victoria Hospital, Montreal, P.Q., Canada)

The experimental studies of Loosli and Robertson (see, for example, Robertson: Ann. Int. Med. **18:** 1, 1943) are reviewed, and the following conclusions as to the pathogenesis of acute pneumococcal pneumonia are reached: (1) An inhaled fluid laden with bacteria passes under the influence of gravity into the most dependent bronchus of the tracheobronchial tree at the moment and thence, *via* the intrabronchial route, to the alveoli. (2) An acute inflammatory reaction is set up, characterized by a rapid outpouring of edema fluid into the alveoli of the lobules involved. (3) The inflammation is rapidly disseminated circumferentially largely by way of the interalveolar communications and the relationship with the bronchial segment promptly disappears. (4) Consolidation begins at the periphery of the lung at the site of infection and progresses toward the hilus, with a sharp line of demarcation usually existing between the advancing front of consolidated parenchyma and the unaffected contiguous lung.

It is reasonably safe, the authors believe, to assume that the process is similar in man. It is thus in contrast to bronchopneumonia and obstructive pneumonitis which localize to one or more specific bronchial segments. A knowledge of this fact gives the advantage of prompt specific therapy as well as aiding the radiologist in differentiating alveolar exudation of nonsegmental distribution from obstructive pneumonitis occurring with lung cancer.

A review of the radiological findings in 56 unselected cases of proved pneumococcal pneumonia showed 49 of these (87 per cent) with consolidation involving less than a complete lobe. Of the 49 cases, 44 were nonsegmental in distribution and revealed other characteristics on which a diagnosis of pneumococcal etiology could be based.

Twenty roentgenograms; 4 photomicrographs; 3 drawings; 1 table.

Lt. Col. HARWOOD N. STURTEVANT, M.C.
Lackland AFB, Texas

Clinical Manifestations of Pulmonary Blastomycosis. Robert S. Abernathy. Ann. Int. Med. **51:** 707–727, October 1959. (University of Arkansas School of Medicine, Little Rock, Ark.)

The author reviews a series of 35 cases of blastomycosis. Multisystem involvement was the rule, being seen in 28 patients. Three had disease localized solely in the skin or subcutaneous tissues, and 4 had pulmonary disease only. The duration was variable, ranging from a fulminating course, fatal within three months of onset, to one stretching out over at least eighteen years. This variability makes evaluation of therapy difficult. The stilbamidines have been used in varying dosage. Amphotericin was given in 12 cases, with promising immediate results, but final assessment of its value requires further observation.

Of the 35 patients, 27 had pulmonary involvement and because of its frequency, particular attention was given to this manifestation. Symptoms included cough, fever, chills, hemoptysis, significant dyspnea, and pleuritis. Physical findings were not impressive.

In all of the 27 cases the chest films were abnormal. The most common finding was an "infiltrative reaction," characterized by mottled and irregular densities of varying outlines and sizes; this infiltrate was sometimes accompanied by fibrosis. Pleural reaction occurred in 11 patients, with effusion in 2 and pleural thickening in the other 9. Enlargement of thoracic lymph nodes was present in 7, and rib involvement in 5, the latter usually

in association with pleural change. More infrequent patterns included cavities, miliary lesions, pneumonia, and an appearance suggestive of bronchogenic carcinoma. A striking negative finding was absence of calcification, as reported by others.

The author's experiences with pulmonary involvement in blastomycosis support the concept that the initial infection usually occurs *via* the lungs. In addition to the 4 patients with isolated pulmonary disease, 16 others experienced respiratory disease as the initial clinical manifestation. Also it was noted that the pulmonary disease originally apparent by x-ray often healed leaving no visible abnormalities, allowing the possibility that even those without obvious pulmonary disease may well have had it at some prior time.

It is concluded that the occurrence of parenchymal pulmonary disease in association with cutaneous, pleural, bone, or thoracic node involvement, should strongly suggest the possibility of blastomycosis. However, because of the extremely varied clinical manifestations, this diagnosis should be considered in any pulmonary disease of undetermined origin.

Six roentgenograms; 4 tables.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

Pulmonary Schistosomatic Arteriovenous Fistulas Producing a New Cyanotic Syndrome in Manson's Schistosomiasis. J. Lopes de Faria, J. Valente Barbas, T. Fujioka, Marcos F. Lion, U. de Andrade e Silva, and Luiz V. Décourt. Am. Heart J. **58:** 556–567, October 1959. (Faculty of Medicine, University of São Paulo, São Paulo, Brazil)

A case of pulmonary Manson's schistosomiasis with marked cyanosis, clubbing of fingers, and slight pulmonary hypertension, in a 19-year-old girl, is reported. A biopsy of the lung disclosed numerous schistosomal granulomas and schistosomatic arteriovenous fistulas. Pulmonary function tests revealed no alteration in the broncho-alveolar system, but rather a venous to arterial shunt in the heart or lung, with hyperventilation (possibly due to chemoreceptor reflexes initiated by anoxemia). Cardiac catheterization indicated that the shunt was not in the heart. It showed no increase in systolic pulmonary pressure after exercise but a decrease in the diastolic pulmonary pressure; no lowering of pulmonary pressure after inhalation of pure oxygen; unsaturation of arterial blood even after pure oxygen inhalation; a great decrease in the arteriolar pulmonary resistance and total pulmonary resistance due to increased cardiac output and cardiac index. An unusual angiocardiographic picture was obtained, characterized by a lacework appearance, resembling a diffusely scattered granulation pattern in the lung fields. In addition, there was exceptionally early filling of the pulmonary veins and left atrium.

The arteriovenous fistulas are considered the major factor in the genesis of the cyanosis and explain the results of the pulmonary function tests and findings on cardiac catheterization, and possibly the peculiar angiocardiographic findings. On the basis of this case and 2 previously reported, the authors postulate a new cyanotic syndrome in pulmonary Manson's schistosomiasis, characterized by hepatosplenomegaly, marked cyanosis, slight or absent pulmonary hypertension, and an unusual angiocardiographic picture.

Three roentgenograms; 7 photomicrographs; 2 tables.

Body Section Roentgenography in the Evaluation and Differentiation of Chronic Hypertrophic Emphysema and Asthma. Robert G. Fraser and David V. Bates. Am. J. Roentgenol. **82:** 39–62, July 1959. (Royal Victoria Hospital, Pine Ave., Montreal, P.Q., Canada)

In routine chest roentgenograms of patients with either chronic hypertrophic emphysema or spasmodic asthma, there are a number of similarities, namely, air trapping, a thorax of large volume, and a low diaphragm with reduced respiratory excursion. There is, however, a deficiency in the peripheral arterial vasculature of the lungs in patients with emphysema, as opposed to a normal vasculature in spasmodic asthma. Moreover, abnormal gas-diffusing capacities are observed in emphysema but not in asthma.

The authors' series was studied both clinically and roentgenologically. Clinical pulmonary function tests included (*a*) measurement of forced expiration and maximal mid-expiratory flow rate, (*b*) subdivisions of lung volume and helium-mixing efficiency, (*c*) measurement of CO-diffusing capacity and, in some (*d*) measurement of arterial blood gases. Routine postero-anterior and lateral chest films in deep inspiration and supine anteroposterior body-section roentgenograms in quiet inspiration were obtained. Early in the investigation, four laminagrams were made at 1.0 cm. intervals: one at the mid line, one anterior, and two posterior to the mid line. It was later found that a mid-line section and one 2.0 cm. posterior to the mid line were sufficient. At least two sections are necessary.

The plain films were assessed for (1) air trapping, (2) decreased peripheral vasculature, and (3) cardiac enlargement. The body-section roentgenograms were analyzed for (1) degree of tapering of third, fourth, and fifth stage pulmonary arteries and (2) localization of peripheral artery narrowing. The single most important criterion for the roentgenographic diagnosis of hypertrophic emphysema is the rapid decrease in caliber and disappearance of the peripheral pulmonary artery branches near their third and fourth stage divisions. Each film was read on three separate occasions by one of the authors without knowledge of the patient's name, history, pulmonary function tests or previous radiographic diagnosis.

Group I contained 26 persons who, on the basis of clinical criteria and function tests had established pulmonary emphysema. Twenty-four of these had routine roentgenograms, but in only 8 was emphysema suspected because of peripheral arterial deficiency and severe air-trapping. Cor pulmonale was present in 3 other cases. A consistent diagnosis of pulmonary emphysema was made on each reading of the body-section roentgenograms of 21 of these 26 patients. In 2 patients, one reading was normal; the readings on the other patients were either normal or doubtful.

Group II contained 11 patients who from a clinical history of periods of freedom from dyspnea, as well as a normal resting pulmonary diffusing capacity, were considered to be suffering from spasmodic asthma. Six cases showed significant air trapping on routine chest films and 1 suggested emphysema. All body-section films were regarded as normal, except for one "doubtful" evaluation.

A third group consisted of 6 patients with discrepancies between clinical, physiological and roentgenologic evaluation. These included 2 cases of chronic bronchitis, an alveolar hypoventilation syndrome, a pulmonary infiltration of unknown type with diffusion defect, a

case that was clinically a spasmodic asthma but which had abnormal functional tests during an attack and x-ray evidence of emphysema, and finally, a case which was clinically normal but with functional impairment and normal or doubtful roentgen findings.

The authors feel that body-section roentgenography is technically simple and of more diagnostic value than routine films of the chest in pulmonary emphysema and spasmodic asthma.

Thirty-eight roentgenograms; 3 tables.

CAPT. HOWARD R. GOULD, M.C.
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The Value of Pneumomediastinum in the Differential Diagnosis of Mediastinal Lesions. J. Lissner. Fortschr. a. d. Geb. d. Röntgenstrahlen **91:** 445–456, October 1959. (In German) (Medizinische Universitätsklinik, Frankfurt a. Main, Germany)

The Condorelli technic of pneumomediastinum involves a transtracheal approach and injection of 400 c.c. of oxygen into the mediastinum. It may be combined with laminagraphy and kymography. The author has used the method in 39 cases of mediastinal lesions. No complications have occurred. The case material is not analyzed in the paper, but illustrative examples are given.

The differentiation between thymomas and teratomas is difficult. If a single stalk from the cranial part of the tumor can be demonstrated with pneumomediastinum, it is highly probable that the tumor is a thymoma. A bronchogenic cyst may stimulate a teratoma or any other tumor in the mediastinum. A definite demonstration of its position with displacement of the esophagus and the presence of calcification makes the diagnosis probable. Leiomyoma of the esophagus is a differential diagnostic possibility. The extension of hemangioma or lymphangioma can be demonstrated, but differentiation between these tumors and a teratoma is often impossible.

The thymus and enlarged nodes are separated from the other structures in the mediastinum by oxygen insufflation. The extension and operability of a bronchial carcinoma can be shown, and the exterior anatomy of the vessels in coarctation can be evaluated after oxygen injection.

The author concludes that pneumomediastinum combined with laminagraphy and kymography is a valuable procedure which refines the diagnosis of mediastinal masses even if it does not permit a histologic diagnosis in the majority of cases.

Twenty-six roentgenograms.

ERIK CARLSSON, M.D.
St. Louis, Mo.

THE HEART AND BLOOD VESSELS

The Diagnostic Value of Conventional Radiological Examination of the Heart in Adults. Per Amundsen. Appendix: An Account of the Statistical Analysis of the Relative Heart Volumes of 755 Patients in Various Disease Groups. R. G. Carpenter. Acta radiol. Suppl. 181, 1959. (Ullevål Hospital, Oslo, Norway)

The author undertook to determine the clinical value of the information obtained from conventional roentgenological examination of the heart as performed routinely. The determination of the size of the heart and the evaluation of the individual chambers are considered separately.

The volumetric method based upon the formula of Rohrer and Kahlstorf as modified by Jonsell and others was used for determining heart size. Body surface area is considered the best factor for correlation with cardiac volume.

The material consisted of 755 patients. The cardiovascular condition of each patient was established as completely as possible on the basis of clinical and laboratory findings and follow-up. All patients had been followed for about five years.

The investigation produced evidence that different physiological and pathological conditions have different effects upon the relative volume. A significant sex effect was shown, the relative volume in males being on an average higher than that in females in the same age-disease group. It is felt that the influence of age upon the mean relative volume can be ascribed to the difference in the stage of the disease in different age groups.

The greatest effect upon the relative volume was found to be caused by valvular disease, followed by coronary disease. The effect of elevation of the blood pressure *per se* was found to be small, probably of the same order as that of physical work or physical training.

In the higher age groups an effect upon the relative volume was indicated which is attributed to a certain degree of "coronary disease" (or "ischemic heart muscle disease" or "cardiosclerosis") which cannot be diagnosed clinically and is referred to as "subclinical aging disease."

A certain level of the relative volume seems to exist above which there is a tendency to congestive heart failure. It is suggested that this level, which was found to be higher in men than in women—consistent with the sex effect—should be regarded as the "borderline region" between radiologically "not enlarged" and definitely enlarged hearts.

The prognosis was found to be correlated with the relative volume, the outlook being appreciably better in patients with "not enlarged" hearts than in those with "definitely enlarged" hearts.

The radiological diagnosis of predominance of special chambers must be made with caution, since a chamber actually of normal size may appear enlarged radiologically while an enlarged chamber may appear of normal dimensions. As a general rule it may be accepted that the radiological diagnosis of enlargement with predominance of the left auricle indcates mitral disease, while predominance of the left ventricle points to aortic valvular defect or coronary disease as the most probable cause.

Thirteen figures; 32 tables.

ROBERT S. ORMOND, M.D.
The Henry Ford Hospital

Congenital Deficiencies in the Parietal Pericardium. A Review with 2 New Cases Including Successful Diagnosis by Plain Roentgenography. Kent Ellis, Norman E. Leeds, and Aaron Himmelstein. Am. J. Roentgenol. **82:** 125–137, July 1959. (622 West 168th St., New York 32, N. Y.)

Two cases of congenital deficiency of the pericardium are presented, and the clinical findings in 97 previously recorded cases are reviewed from the point of view of the radiologist. Complete absence of the left pericardium is the most common type of defect, being found in the authors' 2 patients and in at least 48 of the reported cases.

The common features on the chest roentgenograms are: (1) a shift of the heart to the left and (2) an unusual cardiac silhouette in the frontal projection. The left heart border is flattened as the heart stretches out over the left dome of the diaphragm. Three convexities are seen along the left heart border: the aortic knob; a long, prominent, and sharply demarcated pulmonary artery segment; and a distinct left ventricular segment. These findings seem to be reasonable in absence of the left pericardium with the resulting more intimate contact between the left lung and the heart and great vessels.

The authors' Case I is the second reported example of pericardial defect associated with spontaneous pneumothorax. In this instance the diagnosis of congenital pericardial defect was not seriously entertained prior to surgery. In Case II the diagnosis of congenital left pericardial deficiency was suggested on the basis of the appearance of the plain chest roentgenograms and in the absence of specific abnormality on cardiac catheterization and angiocardiography. A diagnostic pneumothorax successfully substantiated the diagnosis. Pneumothorax, however, may not always yield diagnostic information since, in some cases of deficiency of the left pericardium, adhesions might prevent accumulation of gas over the right surface of the heart. In general, pericardial defects large enough to give the type of cardiac configuration demonstrated in the authors' 2 cases can be expected to show gas in the pericardium if roentgenograms in the proper projections are obtained. The most impressive roentgen demonstration was made utilizing a horizontal beam, with the patient lying on the left side in a slightly right posterior oblique position in relation to the film. This projection is considered optimal in that the right heart border is not superimposed on the spine, and yet gas in the left pleural space, with the help of gravity, has an opportunity to penetrate fully the pericardial cavity.

Cardiac fluoroscopy cannot be expected to provide much help in the positive diagnosis of pericardial deficiency. Case II exhibited prominent cardiac pulsation at fluoroscopy but, in the absence of necropsy, additional cardiac pathology cannot be excluded. Angiocardiography helps rule out other cardiac abnormalities and accentuates the unusual cardiac configuration; it has, of course, little positive value for diagnosis.

Traumatic, surgical, neoplastic, and inflammatory processes may produce pericardial defects, but these mechanisms can ordinarily be suspected from the clinical history.

Fourteen roentgenograms; 1 table.

A Study of Combined Mitral and Aortic Stenosis. Joseph F. Uricchio, Kampta P. Sinha, Lamberto Bentivoglio, and Harry Goldberg. Ann. Int. Med. **51:** 668–678, October 1959. (249 N. Broad St., Philadelphia 7, Penna.)

A review was made of the clinical and hemodyamic pattern in 141 surgically proved cases of combined mitral and aortic stenosis. When possible, comparisons were made with a larger series of 2,000 cases of pure mitral stenosis and 350 cases of pure aortic stenosis.

A previous history of rheumatic fever was obtained in about half of the cases of combined mitral and aortic stenosis. As in isolated mitral or aortic stenosis, associated dyspnea and fatigue were present in about 9 out of 10 cases; 6 to 7 out of 10 patients had edema; 3 out of 10 had hemoptysis; 2 out of 10 emboli; and nearly 4 out of 10, nocturnal dyspnea. The incidence of angina and syncope was about half that in pure aortic stenosis.

The heart was moderately enlarged on roentgen examination in 84 per cent of the cases. Left atrial dilatation was present in every patient, but never assumed the massive proportions sometimes seen in mitral regurgitation and rare forms of mitral stenosis. The pulmonary artery, or one of its major branches, was invariably increased in size. In contrast, the ascending aorta was dilated in less than 20 per cent of the series, even after careful examination in the left anterior oblique position.

Thus there was no recognizable typical configuration of the heart in combined mitral and aortic stenosis, the picture generally resembling that seen in mitral stenosis, rather than isolated aortic stenosis.

Cardiac catheterization data are rather fully reported. Cardiac output was found to be compromised to a greater degree in the combined group than in isolated obstructive valve lesions. However, the marked elevation of the calculated pulmonary resistance and mean pulmonary artery pressure sometimes seen in isolated stenosis was not encountered.

Three roentgenograms; 4 graphs; 1 table.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

The Relationship Between Pulmonary Arterial Pressure and Roentgenographic Appearance in Mitral Stenosis. Charles B. Moore, William L. Kraus, Donald S. Dock, Edward Woodward, Jr., and Lewis Dexter. Am. Heart J. **58:** 576–581, October 1959. (Peter Bent Brigham Hospital, Boston, Mass.)

The prominence of the pulmonary arterial segment on the postero-anterior roentgenogram of the chest in a group of 56 patients with mitral stenosis was assessed by calculation of the "PA/chest ratio." The distance from the midline, as defined by the vertebral spines, to the point of the pulmonary arterial segment farthest left on the cardiac silhouette is measured and divided by one-half of the transthoracic diameter, as suggested by Ozawa (Clinical and Pathophysiologic Studies in Acquired Valvular Diseases. [In] Studies on Cardiac Surgery, 1958).

A positive correlation between the PA/chest ratio and pulmonary arterial mean pressure was found. The correlation was exponential in character, resembling the shape of the pressure-volume curve.

The correlation between PA/chest ratio and pulmonary arterial mean pressure is poor in patients with left-to-right shunts and increased pulmonary blood flow.

In patients with mitral stenosis, in whom pulmonary blood flow varies over a relatively narrow range, the PA/chest ratio is a useful guide to the presence or absence of pulmonary vascular disease, facilitating preoperative evaluation of these patients without cardiac catheterization.

One roentgenogram; 1 graph; 1 table.

Acute Pericardial Fat Necrosis. Report of a Case. Martin H. Chester and John B. Tully. J. Thoracic & Cardiovas. Surg. **38:** 62–66, July 1959. (J. B. T., Hawthorne Community Hospital, Hawthorne, Calif.)

A case of acute pericardial fat necrosis treated by surgery thirteen days after the acute onset of symptoms is reported. A 46-year-old carpenter experienced sud-

den left lower anterior chest pain and cramping epigastric pain during an intense lifting effort. The pain radiated to the left shoulder and increased in severity on deep inspiration. Subsequently, it became excruciating and caused a brief episode of syncope. The admitting diagnosis was acute myocardial infarction. A chest roentgenogram taken at the time of an upper respiratory infection ten days previously was found to be within normal limits.

The patient was tall and thin. He was unable to take a deep breath because of the exacerbation of the chest pain. Respirations were rapid and shallow, blood pressure 98/68 mm. Hg, and pulse 126. Auscultation of the chest elicited normal breath sounds and fremitus in the lung fields. An unusual, soft, low-pitched rub was heard during expiration, synchronous with systole at the cardiac apex. This sound closely resembled that produced by compressing a wet sponge; it could be easily distinguished from the classical friction rub of a pericarditis. The rub disappeared on the third day. An electrocardiogram was normal except for an occasional ventricular presystole. A chest roentgenogram showed a juxtacardiac mass along the anterior aspect of the left cardiac border. Tomograms of this mass revealed several ovoid areas of decreased density. Although the patient's general condition improved considerably, the left chest pain persisted. Exploratory operation disclosed a firm ovoid mass, measuring 10 × 7 cm., identified as the pericardial fat pad. Histologic examination of the specimen showed acute hemorrhagic infarction with considerable interstitial hemorrhage and necrosis of the blood vessels.

The present case negates the concept that pericardial fat necrosis occurs only in the obese. The onset of acute symptoms during severe exertion suggests a traumatic etiology. Although the pathogenesis of this lesion is still obscure, it is possible that its onset is primarily a "vascular accident" with resultant extravasation of blood from an artery, hematoma formation, and thrombosis. Consequently, the blood supply to the fatty tissue is compromised, with resultant ischemic fatty necrosis. A consideration of this syndrome is warranted in any patient with unexplained precordial pain, pleuritic pain in the left lower chest, and an associated juxtacardiac mass.

Four roentgenograms; 1 photograph; 2 photomicrographs.

Cardiac Aneurysm with Ventricular Tachycardia and Subsequent Excision of Aneurysm: Case Report. O. A. Couch, Jr. Circulation **20**: 251–253, August 1959. (Vanderbilt University School of Medicine, Nashville, Tenn.)

A patient who had suffered a rather extensive anterior myocardial infarct exhibited a localized bulging of the left heart border which showed diminished pulsation. A diagnosis of ventricular aneurysm was made. Following healing of the infarct, episodes of ventricular tachycardia began to occur and finally could be controlled only by continuous exact dosage of quinidine. The presence of an aneurysm was confirmed by roentgenkymography and left cardiac atriography. Following its removal the postoperative course was satisfactory with no recurrence of the arrhythmia in spite of the discontinuance of quinidine.

Two roentgenograms; 3 electrocardiograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Congenital Kinking of the Aortic Arch. J. N. Pattinson and R. G. Grainger. Brit. Heart J. **21**: 555–561, October 1959. (Middlesex Hospital, London, England)

The normal aortic arch presents as an even convex loop, inclined at about 30° to the sagittal plane. In congenital kinking there is an acute kink in the descending portion of the arch, with an angular convexity directed forward, downward, and slightly to the right at the level of the ligamentum arteriosum. The kink occurs at the aortic isthmus, where there is normally a faint indentation on the concavity of the aortic arch immediately proximal to the slight dilatation of the upper descending aorta. The aorta proximal to the kink is elongated and rises higher in the mediastinum than usual. The apex of the abnormal kink is closely applied to the upper and posterior aspect of the left pulmonary artery and left main bronchus, which may be displaced forward, downward, and to the right. The esophagus also is usually displaced forward and to the right. The aorta immediately distal to the kink may be dilated.

In the postero-anterior chest film this anomaly presents as an oval opacity, less opaque than a normal aortic arch, situated high up on the left superior mediastinal border. It lies higher than the usual aortic arch and therefore may be mistaken for a tumor. Overlapping its lower pole is a second opacity of greater radiodensity with a sharply defined convex upper border. This is an end-on view of the descending aorta immediately distal to the kink.

In the left anterior oblique view the high aortic arch, the sharp kink forward at the site of the ligamentum arteriosum, and the backward curve in the normal descending aorta are well demonstrated. These findings may be better shown by tomography in this projection.

The right anterior oblique view shows the ascending aorta and aortic arch in profile, superimposed. The aorta immediately distal to the kink, running horizontally backward and to the left, produces a dense round shadow behind and below the aortic arch.

The postero-anterior projection with a barium swallow shows that the aorta immediately distal to the kink deeply indents the left border of the esophagus. Occasionally, a long continuous esophageal concavity is formed by the combined indentation of the arch and "post-kink" segment of the aorta. In the left anterior oblique view, with barium, there is forward displacement of the esophagus by the aorta distal to the kink, similar to that produced by the post-stenotic segment in coarctation of the aorta.

The radiological diagnosis of kinked aortic arch is of clinical and practical importance, mainly in preventing the diagnosis of superior mediastinal tumor and perhaps avoiding special radiographic studies and thoracotomy. Although the radiological appearances may be reproduced exactly in the more frequent condition of coarctation of the aorta, the absence of hypertension in the arms and head, the normal femoral arterial pressure, the absence of clinically or radiologically evident collateral circulation, and the normal size of ascending aorta, will exclude significant coarctation.

If a loud basal heart murmur is heard in this condition, it is presumed to be due to the turbulence of the blood flow through the sharply kinked vessel.

The kinked aortic arch is believed to be a congenital malformation associated with a short, taut ligamentum arteriosum and an unduly long aortic arch segment. The kinking of the congenitally buckled aortic arch will

be increased by the elongation of the aorta which may occur in later life from hypertension and arteriosclerosis. The accentuation of the radiological appearances produced by these secondary changes may account for the fact that in the majority of the recorded cases of kinked aortic arch, the age of the patient has been thirty years or more.

Eight roentgenograms; 4 diagrams.

JOHN P. FOTOPOULOS, M.D.
Northwestern University Medical School

Takayasu's Disease: A Case Report with an Angiocardiographic Study. John Cosma, Yosh Maruyama, J. R. Pettet, and Vincent Cutshall. Circulation **20:** 267–272, August 1959. (Tokyo Army Hospital, Tokyo, Japan)

"Pulseless disease" is a rare form of arteritis of unknown etiology seen mostly in young Japanese females, involving mainly the aorta and its proximal branches. Progression is the rule, with death due to cerebral vascular insufficiency. Symptoms and signs include pain and tenderness in the extremities, headaches, dizziness, syncope, paralyses, etc. There may be asymmetry or absence of pulses in any of the arteries in the upper part of the body.

The authors report a case in a young Japanese woman which is of particular interest because of an angiocardiographic study with correlation of the observations with previously recorded pathologic findings. There was extensive involvement of the aorta and its brachiocephalic branches. The entire thoracic aorta exhibited alternating stenosis and dilatation, indicating that, despite the early clinical stage of the disease, involvement was extensive. Intravascular thrombus formation was a prominent feature. The vertebral arteries also showed some dilatation, due perhaps to the extra load they were forced to carry because of gradual obstruction of the flow through the carotid arteries.

It is pointed out that the particular pattern of involvement demonstrated by this study should not be interpreted as the only one possible.

Six roentgenograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Cardiac Effects of Intracoronary Arterial Injections of Various Roentgenographic Contrast Media. Santiago V. Guzman and James W. West. Am. Heart J. **58:** 597–607, October 1959. (J. W. W., University of Pennsylvania, School of Medicine, Philadelphia 4, Penna.)

The cardiac effects of intracoronary arterial injections of various contrast substances on coronary blood flow, myocardial contraction, and the electrocardiogram were studied in 22 normal adult mongrel dogs. Urokon, Hypaque, Cardiografin, Renografin, and Diodrast (in the descending order of effectiveness) produced cardiac arrhythmias and ST-T wave changes in the electrocardiogram, depressed the contractile force of the heart, and caused a drop in blood pressure.

Diodrast, Renografin, and Cardiografin elicited minimal to moderate ST-T wave changes as compared to Hypaque and Urokon. Urokon appeared to be the most toxic of the group, since it often led to ventricular tachycardia. Ventricular fibrillation developed in 6 of the 22 dogs studied during intracoronary arterial injection of Urokon (70 per cent) and in 2 dogs after intracoronary injection of Hypaque (50 per cent), whereas comparable doses of Diodrast (70 per cent), Renografin (76 per cent), and Cardiografin (85 per cent) were not followed by this fatal outcome. All the radiopaque substances studied elicited a slight and transient increase in heart rate accompanied by a fall in blood pressure following coronary arterial injection. Urokon, however, on many occasions caused transient A-V heart block. This effect was not abolished by bilateral vagotomy, but it disappeared after atropine.

The effect of the different media on myocardial contractility was investigated in 10 dogs. The degree of myocardial depression was most marked and persistent with Urokon and least marked with Diodrast.

A total of 48 observations in 5 dogs was made on the effects of intracoronary contrast injections on coronary blood flow. Diodrast produced the greatest and most lasting effect, increase in coronary blood flow persisting even after the electrocardiogram became normal.

Intracoronary arterial injections of the various contrast media caused a drop in systemic blood pressure which coincided with the electrocardiographic changes. The degree of fall in pressure appeared to parallel the degree of change in the T wave.

Each animal received 2 to 4 injections (coronary arterial) of each medium studied. The cardiac effects in the various parameters diminished following repeated injections. Thus, although an initial dose of any of the media will produce electrocardiographic changes and cardiac depression, a third or fourth injection of the same dose will elicit little or no response.

Six figures.

Congenital Coronary Arteriovenous Fistula Associated with Large Patent Ductus. Lewis H. Bosher, Jr., Sverre Vasli, Carolyn Moore McCue, and Lester F. Belter. Circulation **20:** 254–261, August 1959. (Medical College of Virginia, Richmond, Va.)

Coronary arteriovenous fistula is a rare congenital anomaly diagnosable in life only recently by means of coronary arteriography. The anomalous communication may involve any part of the heart, most often the coronary sinus or the right atrium. The coronary artery usually shows aneurysmal dilatation.

In the authors' case a large patent ductus was the outstanding feature, causing cardiac failure as early as four months of age. At twenty-seven months retrograde aortography was done. The pulmonary artery and right heart opacified at half a second and a patent ductus was thought to be visible. Half a second later there was opacification of the right atrium and hepatic veins. The pulmonary artery was obviously quite large. On the basis of these findings a tentative diagnosis of patent ductus arteriosus with pulmonary and tricuspid insufficiency was made. Surgery was done and the ductus was divided. A thrill persisted over the right atrium, however, prompting further exploration. This revealed a large anomalous vessel leading from an aneurysmal dilatation near the origin of the left coronary to empty into the right atrium. The vessel narrowed to 2 mm. at its termination. Postoperatively the child appeared to be doing well but died suddenly at about thirty hours, apparently from an arrhythmia.

Ten illustrations, including 6 roentgenograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Venography of the Inferior Vena Cava. C. G. Helander and Å. Lindbom. Acta radiol. **52:** 257–268, October 1959. (Karolinska Sjukhuset, Stockholm, Sweden)

The authors earlier reported their experience with

venography of the inferior vena cava in the diagnosis of expansive retroperitoneal processes (Acta radiol. **45**: 289, 1956. Abst. in Radiology **68**: 288, 1957). They now present their total experience with the procedure, covering 315 cases, with pathologic changes in 89. The contrast medium, 30 per cent Urokon, is injected simultaneously into both common iliac veins by Seldinger's catheterization technic (Acta radiol. **39**: 368, 1953. Abst. in Radiology **62**: 466, 1954).

The inferior vena cava caudal to the origin of the renal veins had a greater frontal than sagittal diameter, while the cranial portion was flattened from side to side in passing through the liver. Occasionally, the valve of the vena cava in the right auricle was observed. The caudate lobe of the liver was often discernible as a regular arciform impression in the left wall and the right renal artery produced a defect in the posterior wall of the inferior vena cava. The most common anatomical anomaly was persistence of the left vena cava.

Since an elongated aorta tends to curve to the left, it will not in general produce an impression in the vena cava unless a large aortic aneurysm is also present. Contrast filling of the sacral and lumbar veins in cavography without Valsalva's maneuver was found to be due to stenosis either of the vena cava or the common iliac vein, uni- or bilaterally. However, the possibility of the catheter tip having accidentally entered the ascending lumbar vein must first be ruled out. Enlarged lymph nodes, situated between the aorta and the vena cava and behind the vena cava, displaced the vena cava forward and to the right at the level of the first to the third lumbar vertebrae. Cavography was usually the only means of demonstrating retroperitoneal metastasis and evaluating the results of radiotherapy, *e.g.*, in lymphomas and seminomas.

Twenty-three roentgenograms.

CAPT. SAMUEL S. KRIKORIAN, M.C.
Lackland AFB, Texas

Aneurysm of Renal Artery Causing Hypertension: Report of Three Cases. Charles Pierre Mathé. J. Urol. **82**: 412–416, October 1959. (450 Sutter St., San Francisco 8, Calif.)

Since 1932, the author has treated 10 patients with aneurysm of the renal artery, 3 of whom had associated hypertension. Of these 3, 2 had nephrectomies of the involved kidney with subsequent dramatic relief of their hypertension. In 1957, Garritano found 180 cases of renal artery aneurysm in a review of the literature since 1948, with hypertension in 49 (Am. J. Surg. **94**: 638, 1957).

Although the mechanism for hypertension associated with aneurysm of the renal artery is unknown it is postulated that there is interference with the renal circulation and a secondary abnormal secretion of a pressor substance, such as angiotonin.

A broken, wreath-like shadow seen on a supine roentgenogram of the abdomen in the area of the renal shadows should suggest to the roentgenologist the diagnosis of aneurysm of the renal artery. Aortography reveals puddling of the contrast medium within the calcified ring. Aortography is also the only method of detecting a noncalcified aneurysm.

Because of the likelihood of concomitant parenchymal renal disease in patients with associated hypertension the treatment of choice is nephrectomy, except for a solitary kidney or when both kidneys are involved. Without associated hypertension, surgical measures, such as aneurysmectomy, with or without arterial grafts, or substitution of the involved renal artery by the mesenteric or splenic artery, may be considered.

Aneurysm of the renal artery should always be considered a possible etiologic factor in unexplained hypertension.

Four roentgenograms; 1 drawing.

ROBERT E. CAMPBELL, M.D.
University of Pennsylvania

Distribution of Renal Arterial Circulation in the Dog. Hans J. Klapproth. J. Urol. **82**: 417–423, October 1959. (Cleveland Clinic Foundation, Cleveland, Ohio)

The author describes the results of dissection and angiography of 100 canine kidneys. The demonstrations establish that the pattern of branching of the renal artery and the vascular segmentation of the kidney in dogs are comparatively constant and significantly different from those in man. It is important to be aware of this difference when observations made in dogs are to be applied to man.

The most striking difference between the two is the almost perfect symmetry of the anterior and posterior hemisphere in the canine kidney and the division of the main artery into an identical number of secondary and tertiary arteries. In the human kidney the main renal artery divides into one posterior branch, which supplies approximately two-thirds of the posterior hemisphere, and three anterior branches which supply the whole anterior hemisphere plus a segment of the upper and lower poles of the posterior hemisphere.

As in the human kidney, there is no evidence of intrarenal collaterals between neighboring vascular segments of the hypothetical lobes of the canine kidneys.

The author found that 6 per cent of the canine kidneys in their series had two main arteries of equal caliber; Merklin and Michels reported 10 per cent in human kidneys (J. Internat. Coll. Surgeons **29**: 41, 1958). As compared with man, there is a noteworthy absence of so-called accessory arteries, although there are uniformly present a number of transcapsular collateral arteries.

Twenty-one roentgenograms; 4 diagrams.

JOSEPH M. WINSTON, M.D.
University of Pennsylvania

A Comparison of the Traumatic Effect of Different Roentgen Contrast Media on the Blood Vessels. G. Zinner and R. Gottlob. Fortschr. a. d. Geb. d. Röntgenstrahlen **91**: 507–512, October 1959. (In German) (Die urologische Abteilung des Krankenhauses Rudolfstiftung, Vienna, Austria)

Several workers have tried to demonstrate damage to the vascular endothelium after exposure to highly concentrated contrast media. The attempts have been unsuccessful because ordinary histologic technics have been used. The authors employed a modified O'Neill technic (Ann. Surg. **126**: 270, 1947) and found that a relatively large vessel like the anterior facial vein of the rabbit can be used as a model for the capillary endothelium.

The anterior facial vein of the rabbit was punctured in two places 2 cm. apart. The peripheral hole was cannulated. Contrast medium was injected and left in the vein for thirty seconds. After washing with saline, silver nitrate solution was injected. The vein was then removed and prepared for microscopy. Isotonic glucose solution was used as a control.

The authors describe three degrees of endothelial damage caused by contrast media of three types, two tri-iodine media and one di-iodine medium. The findings complement the results of other workers, who have studied the permeability disturbances caused by contrast material. Increased permeability of the vascular endothelium was found to parallel histologic changes. The osmotic pressure is not the deciding factor for the degree of damage, but rather the lack of viscosity in two of the tested media.

Six figures; 2 tables.

ERIK CARLSSON, M.D
St. Louis, Mo.

Device for Timing Cineangiocardiograms Using the Electrocardiogram. Graeme Sloman and J. G. Davies. Lancet **2:** 388, Sept. 19, 1959. (St. George's Hospital, London, S. W. 1, England)

With the increasing use of high-speed cineangiocardiography in the investigation of congenital and acquired heart disease, it has become necessary to time events during the passage of the contrast medium through the heart. Several methods which have been developed require tedious counting of frames and continual reference to the electrocardiogram. The author describes a device which marks each frame of the film. It is then possible to time frames during both systole and diastole irrespective of the camera speed or the heart rate. The marking device is part of an electronic unit which is triggered by the R wave of the electrocardiogram.

Four illustrations.

THE LYMPHATIC SYSTEM

Radiographic Studies of the Lymphatic System. Edward Shanbrom and Norman Zheutlin. Arch. Int. Med. **104:** 589–593, October 1959. (N.Z., U.C.L.A. Medical Center, Los Angeles, Calif.)

The authors describe their technic for the radiographic study of the lymphatic system. The procedure is similar to that of Bruun and Engeset (Acta radiol. **48:** 389, 1956. Abst. in Radiology **68:** 461, 1957). It has been found, however, that when hyaluronidase is injected previous to the contrast medium, enlarged lymph nodes are demonstrated more frequently, especially in Hodgkin's disease. Ethiodol (purified iodized ethyl ester of poppyseed oil, each 1 c.c. containing 37 per cent by weight of iodine) has proved to be the most suitable contrast agent. Thirty-five separate examinations have been carried out in 20 patients with various lymphomas, with little or no discomfort and no complications. Despite the fact that under fluoroscopy it was possible to watch the passage of iodized oil directly into the blood stream, no fat embolisms resulted.

The study was undertaken initially to detect enlarged pelvic or abdominal lymph nodes, and this aim was easily achieved. It was possible to visualize para-aortic nodes by injections in the inguinal and femoral areas. Additional information concerning normal pathways of lymphatic channels has been obtained. It appears, for example, that there is a direct communication of the axillary nodes with the subclavian vein on that side, as the contrast medium could be seen entering the subclavian vessel at several points along its course. This may well explain the poor prognosis in breast cancer once the regional nodes are involved. In one case, injection into the posterior cervical nodes showed multiple lymphatic channels which entered the jugular vein at several points.

The manner in which the oil traversed the lymph nodes was of interest. Under fluoroscopy, the contrast medium could be seen entering the peripheral portion of the node first. With further filling, the central portion became opaque and the contrast material then advanced to the next group of nodes *via* the efferent lymphatics. This confirms the findings of other investigators using Direct Sky Blue.

Ten roentgenograms; 1 drawing.

THE DIGESTIVE SYSTEM

Oesophageal Pressure and Motility in Animals: A Cine-Radiographic and Manometric Study. G. S. Muller Botha. South African M. J. **33:** 915–920, Oct. 31, 1959. (Groote Schuur Hospital, Cape Town, Union of South Africa)

Direct observation of esophageal activity in man remains impracticable. A comparison, however, of cineradiographic and manometric recordings in animals and in man and direct observation of esophageal peristalsis in animals afford some understanding of human esophageal activity. In the present investigation synchronous cineradiographic and manometric recordings were made in monkeys and rabbits. Manometric studies alone were also carried out in the rabbit, monkey, mouse, ferret, guinea-pig, cat, and dog.

The characteristics of the gastroesophageal and esophagopharyngeal withdrawal curves, deglutition complexes, and intraluminal pressure changes were of the same general pattern in all species. The results were similar to those obtained in man, suggesting that the underlying physiological mechanisms correspond.

Functional, if not structural, sphincters were shown to exist at the cranial and caudal ends of the esophagus. These sphincters appear to be integrated into the mechanism of deglutition, relaxing and contracting as part of the propagated primary peristaltic wave which starts in the pharynx and moves to the terminal esophagus.

The study is not yet completed. The results are reported to stimulate further interest in the possibilities of this field of investigation.

Seventeen roentgenograms; 8 pressure recordings.

The Phrenic Ampulla. Geoffrey Hagarty. M. J. Australia **2:** 515–519, Oct. 10, 1959. (Eastwood, New South Wales, Australia)

The phrenic ampulla is the terminal portion of the esophagus with an indefinite upper border, ending at the esophageal sphincter. It is best seen in inspiration after ingestion of thick barium. Normally it distends as the patient continues to hold his breath and the barium moves proximally in the esophagus. It is often confused with hiatal hernia and should be considered before that diagnosis is made. Failure of appearance of a phrenic ampulla would tend to indicate that some pathological process had caused the esophagus to lose its normal elasticity in this area.

Six roentgenograms; 1 drawing.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

The Anatomical and Functional Basis of the Gastro-Oesophageal Reflux as Seen Radiologically. E. Zdansky. German M. Monthly **4:** 331–334, October 1959. (Bürgerspital, Basel, Switzerland)

The author describes in great detail the complex

anatomy and physiology at the gastro-esophageal junction, mentioning the wide variation of opinion as to the anatomical-physiological features of this region. For this segment of the digestive tract he recognizes the following anatomical portions from above downward: lower end of the thoracic esophagus, including the epiphrenic ampulla, the cardiac antrum, the cardia or gastro-esophageal junction, and the gastric fundus. The lower end of the thoracic esophagus is separated from the cardiac antrum by a constriction zone, but a true sphincter in the usual anatomical sense is not present. The cardiac antrum is a short, but definite segment located partly above and partly below the diaphragm. In the normal state the cardiac antrum maintains a prominent contraction phase with localized increased pressure after the food bolus has passed. This is an important feature in preventing esophageal reflux. The transitional point from the distal cardiac antrum to the gastric fundus is termed the "cardia" and is not always anatomically distinct. Some individuals show a "cardiac sphincter" here. Normally the cardiac antrum meets the gastric fundus at a sharply acute or oblique angle, a feature also thought to be of importance in preventing reflux.

In the development of gastro-esophageal reflux the author believes that an important first step is hypermobilization of the cardiac antrum with upward sliding of this segment above the esophageal hiatus. This will stretch and loosen the phreno-esophageal membranes, the lower diaphragmatic fascia, and later the oblique muscle fibers of the gastric fundus. In this same series of events one notes flattening and disappearance of the acute angle of the esophagogastric junction. These features allow reflux and subsequent development of true hernia. The natural tendency of the elastic esophagus to contract and pull upward on the cardiac antrum is also a factor in the development of incompetency.

It is recognized that the described "hiatal insufficiency" is only one step in the development of gastro-esophageal reflux in that there appear to be important reflex and autonomic nervous factors also at play. This is supported by the observation that even in the presence of the described anatomical changes, reflux need not necessarily occur. Conversely, in some individuals in whom reflux is demonstrable, there may be no recognized signs of insufficiency of the gastro-esophageal closing mechanism. Once reflux has been established, a vicious circle may ensue, with shortening of the esophagus, rigidity of the esophagogastric junction area, and the development of further reflux.

The fine anatomical points under discussion are well demonstrated by three line drawings and a series of ten roentgenograms.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Experiences with the "Vigorous Diagnostic Approach" to Upper Gastrointestinal Hemorrhage. Norman M. Scott, Jr. Ann. Int. Med. **51:** 89–98, July 1959. (Brooke Army Hospital, Fort Sam Houston, Texas)

The reliability of the history and physical examination as a clue to the diagnosis in every case of gastrointestinal hemorrhage must be seriously questioned. The early application of appropriate diagnostic techniques is advocated for evaluation of the bleeding patient.

The author reports a series of 85 cases of serious upper gastrointestinal hemorrhage seen in Brooke Army Hospital. The basic requirement for inclusion in this series was continuation of active bleeding after admission to the hospital, indicating a strong possibility that specific measures might be needed for its control. Nearly every patient received at least 1,000 ml. of whole blood during the first six to twelve hours for varying degrees of shock or anemia.

The "vigorous diagnostic approach," advocated by Palmer (Ann. Int. Med. **36:** 1484, 1952) and employed in this series, requires that efforts first be directed toward resuscitation, if it is necessary, by the usual measures. As soon as the patient's condition permits, gastric lavage with ice-water is carried out, followed at once by esophagoscopy, gastroscopy, and finally a barium-contrast upper gastrointestinal roentgen examination.

Ideally, none of these procedures should be omitted, nor should the order in which they are carried out be varied, though conditions in the individual case must be taken into consideration. Gastroscopy was performed in only 28 cases, being precluded in some instances by positive identification at esophagoscopy of hemorrhage from an esophageal lesion, while in others completely normal esophagoscopic findings were considered to be sufficient evidence that the bleeding was from below the diaphragm. In these latter cases it was felt that gastroscopy would add little information. This is admittedly a calculated risk, since some instances of gastric varices and diffuse hemorrhagic gastritis might have been missed. Roentgen examination was omitted in 12 instances, either because it had been done within a few days prior to the hemorrhage or the severity of the hemorrhage and the patient's condition dictated immediate laparotomy.

No patient suffered injury either by endoscopic accident or intensification of the hemorrhage, as a result of these early diagnostic studies. Indeed, ice-water lavage stopped or significantly reduced the rate of bleeding in the majority of instances, whatever its source.

The initial "impression" was correct in only 48 (or 56.4 per cent) of the 85 cases studied. In 25 instances (or 29.4 per cent) it was proved incorrect, and in 12 (or 14.2 per cent) no definite source of the bleeding could be demonstrated. In 11 instances (12.9 per cent) the bleeding proved to be from such unexpected sources that treatment directed at the suspected cause would have been totally ineffective or even harmful.

Hemorrhage alone was considered to be directly responsible for the deaths of 4 patients (4.7 per cent) of this group. Nine others died, but in each instance, the "vigorous diagnostic approach" had permitted specific application of measures which successfully controlled the bleeding, and death was due to other causes indirectly related to the hemorrhage. In every patient who died, the "vigorous diagnostic approach" had permitted optimal management of the initial hemorrhage.

Two tables.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Analysis of Motility in the Carcinomatous Stomach. G. Wilhelm and J. Schaaf. Radiol. clin. **28:** 160–174, May 1959. (In German) (Röntgenabteilung der Medizinischen Universitäts-Poliklinik, Heidelberg, Germany)

The authors review the physiology of gastric peristalsis and describe methods of its registration, especially by use of "polygraphy." On the basis of 4 selected

cases, the characteristic changes in the peristalsis of the stomach in carcinoma are presented.

Changes in peristalsis are usually pathological, but do not necessarily indicate the extent of a tumor. Peristalsis may be increased on the opposite curvature and diminished on the involved curvature. If the innervation of the stomach is involved, decrease in peristalsis may occur in areas which are not infiltrated by tumor.

Occasionally passive motion may occur in the region of the tumor as a result of transmitted peristalsis, either around or through the area of infiltration.

Nine roentgenograms; 4 photographs.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

Leiomyosarcoma of the Stomach: A Review of Ten Cases. Peter M. Masley. Am. J. Digest. Dis. **4:** 792–811, October 1959. (St. Vincent's Hospital, New York, N. Y.)

The author reviews the literature on leiomyosarcoma of the stomach, commenting on its rarity and the absence of any pathognomonic signs and symptoms that will establish the diagnosis. Radiography will confirm the existence of a gastric lesion, but seldom indicates its nature. The demonstration of a large tumor in the epigastrium and the presence of barium outside the normal confines of the stomach should suggest such a lesion, as should the roentgenologic syndrome of a filling defect, central niche, and fistula.

The tumor is radioresistant, and surgery is indicated. Metastasis is slow to occur, and the prognosis is far better than for carcinoma.

Ten cases are reported here. In this series there were 3 long-term survivals, 1 of five years and 2 of ten years.

GORDON L. BARTEK, M.D.
Grand Rapids, Mich.

Perforation of the Stomach Due to Retroperitoneal Neurinoma: A Case Report. J. Róka and L. Holczinger. Am. J. Digest. Dis. **4:** 812–816, October 1959. (Medical University, Debrecen, Hungary)

Neurinomas may be intracranial or peripheral. Peripheral tumors occur most frequently in the upper limbs, hands, neck, scalp, face, tongue, and stomach, and may be associated with peptic ulceration and bleeding. The tumors are well circumscribed and encapsulated, and the larger ones may undergo cystic degeneration. The radiologic appearance of gastric or retroperitoneal neurinomas is similar to that of other tumors and may suggest carcinoma. Even though the tumor is large, the state of the patient may be surprisingly good, as in the case reported here.

The stomach in this instance was of fish-hook shape, reaching below the crest of the ilium. The folds of the upper third of the greater curvature were of uneven contour and at their upper end was an irregular blind pouch in which barium remained at forty-eight hours. The diagnosis was perforation of the stomach by a tumor, probably benign. The surgical procedure is described in detail as is the pathology. The final diagnosis was retroperitoneal neurinoma connected with the stomach wall and tail of the pancreas. The central area had become necrotic and perforated into the stomach. The patient was well two years postoperatively.

Three figures, including 1 roentgenogram.

GORDEN L. BARTEK, M.D.
Grand Rapids, Mich.

Adult Hypertrophic Pyloric Stenosis. Report of Two Cases with Variable X-Ray Findings. Harry C. Mack. Arch. Int. Med. **104:** 574–579, October 1959. (6071 W. Outer Drive, Detroit 35, Mich.)

Hypertrophic pyloric stenosis occurs often enough in the adult to warrant consideration in the differential diagnosis of upper gastrointestinal conditions. Some investigators (see, for example, Kleitsch: Arch. Surg. **65:** 655, 1952. Abst. in Radiology **61:** 451, 1953) believe the symptomatology and radiologic findings to be sufficiently characteristic to permit a clinical diagnosis of this entity. The author reports 2 cases, one focal and the other diffuse, with atypical symptoms and roentgen findings, in which it was impossible to arrive at a definitive diagnosis without resort to exploratory surgery.

The first patient, a 50-year-old man, had symptoms attributed to a peptic ulcer for over a year. Roentgen examination, including repeated upper gastrointestinal series, disclosed a persistent narrowing of the prepyloric area which changed slightly in contour with peristalsis, along with a slight irregularity adjacent to the narrowed segment, interpreted as an ulcer crater. There was no evidence of retention of the contrast medium. At operation, a mass was found in the region of the pylorus, with a few soft nodes in the gastrocolic ligament. The duodenum was freely mobile, with no evidence of ulceration or scarring. A wedge resection of the mass was performed; microscopic examination disclosed no malignant characteristics. A 50 per cent gastric resection and a Billroth I type of anastomosis were carried out. The final diagnosis was idiopathic hypertrophy of the pylorus.

The second patient, a 67-year-old woman, complained of intermittent nausea for one and a half years. She had had a mastectomy for cancer at the age of thirty-seven. Gastrointestinal x-ray studies repeatedly showed a "mass in the stomach," but gastroscopy failed to reveal its nature. At operation, a soft tumefactive process was palpated in the prepyloric region, on the lesser curvature. There were numerous adhesions over this area of the pylorus, extending to the liver and gastrohepatic omentum. A 60 per cent gastric resection with Billroth II anastomosis was carried out. Microscopic examination showed a marked hypertrophy of the smooth muscle of the stomach, without evidence of infection, ulceration, or neoplasm.

The surgery was tolerated well by both patients and appeared to be curative.

An abrupt narrowing of the pyloric canal in contrast to a well distended gastric antrum seems to be a constant feature in adult hypertrophic pyloric stenosis. A smooth, regular contour of the stomach proximal to the pyloric defect, along with regular straight mucosal folds in the pylorus, indicates a lack of mucosal involvement. Elongation and fixation of the pyloric canal, the "pyloric string sign," and a smooth crescentic invagination of the base of the duodenal bulb, as described by Kirklin and Harris (Am. J. Roentgenol. **29:** 437, 1933. Abst. in Radiology **22:** 641, 1934), though suggestive of hypertrophic pyloric stenosis, are not diagnostic of the lesion. Indentations, filling defects, and barium projections are observed in focal hypertrophy of the torus or other segment of the circular musculature.

A pyloric ulcer with cicatrization, an encircling myoma, a gastric cancer or eosinophilic granuloma, pancreatic anomalies, and tumors with secondary gastric involvement must be considered in the differen-

tial diagnosis of a chronic partial pyloric obstruction in the adult.

Three roentgenograms; 1 drawing; 1 photomicrograph.

Arterio-Mesenteric Duodenal Occlusion (Report of 8 Proven Cases). Rudolfo M. Lontok and Kenneth W. Taber. Pennsylvania M. J. **62:** 1529–1533, October 1959. (Sacred Heart Hospital, Allentown, Penna.)

Clinical, anatomical, pathologic and radiologic features of arteriomesenteric duodenal occlusion are reviewed briefly. Statistics show this entity to be three times as prevalent in females as in males. It occurs generally in constitutionally poor, asthenic, highly emotional individuals. A neuromuscular disturbance in the duodenum has been held responsible, but this explanation the authors question. They believe, rather, that the syndrome represents a direct anatomical situation in which the transverse part of the duodenum, sandwiched between the spine and aorta behind and the superior mesenteric vessels in front, is obstructed by extrinsic pressure. Characteristic radiologic features include more or less complete obstruction at the mid part of the transverse duodenum, demonstrated by barium studies with the patient erect. Gentle upward pressure on the lower abdomen (Haye's maneuver) or assumption of the knee-chest position will result in prompt relief of symptoms and obstruction. Treatment is surgical correction by side-to-side duodenojejunostomy anterior to the mesenteric vessels. This should be contemplated, however, only after conservative measures have failed.

Eight brief case reports demonstrating the points under discussion are presented.

Four roentgenograms.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

On Routine Barium Examination of the Small Bowel. F. O. Brown. Lancet **2:** 530–533, Oct. 10, 1959. (Stirling Royal Infirmary, Stirling, Scotland)

An inquiry was made into the value of routine follow-through examinations of the small bowel or ileocecal region during regular barium sessions without any special procedures. Relevant files were examined and 190 cases were found for review. Referral had been by physicians (106 cases) oftener than by surgeons (84); there were more outpatients (120) than inpatients (70), and more women (107) than men (83). The methods used by 8 radiologists fell midway between the simplest form of examination, in which only one or two films were obtained after the meal, and the more extended study in which films were taken hourly during the morning and afternoon, with additional screening and twenty-four-hour roentgenograms as a routine.

Abnormalities were demonstrated radiologically in 11 of the 190 cases. All of these had been suspected clinically prior to the examination. Abnormal conditions which were not discovered by x-ray included a blind-loop syndrome; subacute obstruction from inguinal hernia (2 cases); large carcinoma of the head of the pancreas; Meckel's diverticulum (2 cases); subacute Crohn's disease; steatorrhea (8 cases).

A technic for accelerating the passage of barium through the small bowel is thought to provide a quicker method of examination, one which also shows improved mucosal detail and produces better filling of the whole small intestine, making possible a personal examination of the ileocecal region. Two procedures for doing this are given in detail: the isotonic saline technic of Weintraub and Williams (Am. J. Roentgenol **61:** 45, 1949. Abst. in Radiology **53:** 895, 1949) and the soda-water method of Bendick (Diagnostic Advances in Gastrointestinal Roentgenology. New York, Grune & Stratton, 1954. Reviewed in Radiology **64:** 747, 1955).

In the last three months of 1958, the author employed Bendick's method, modified to suit local conditions of work, in a study of 43 cases. Over 60 per cent of this group of patients were on their way home or back to the ward in under two hours, and in every instance the upper and middle alimentary tract had been examined more thoroughly than in the usual way. All except 1 were reported normal and, so far as was known in January 1959, nothing was missed.

Calcification in Carcinoma of the Colon. G. J. Green. J. Fac. Radiologists **10:** 219–220, October 1959. (Cardiff Royal Infirmary, Cardiff, Wales)

The author presents a case of calcification in a mucoid adenocarcinoma of the colon. To date, 13 cases of gastrointestinal carcinoma with calcification have been reported and all have shown evidence of mucoid degeneration. Only 1 case similar to the author's is believed to have been published (Matthews *et al*: Gastroenterology **34:** 959, 1958. Abst. in Radiology **72:** 615, 1959).

Plain films of the abdomen showed some irregular streaks of calcification interwoven with some less dense streaky opacities forming a lattice pattern overlying the right iliac crest. On barium enema examination, the flow of barium was held up in the ascending colon at the level of the calcification, and the diagnosis of a tumor of the ascending colon was made. This diagnosis was confirmed at operation.

Previous authors have suggested that the pattern of the calcification in these cases may be diagnostic. The present case did not conform to the previous descriptions.

Four roentgenograms.

THEODORE E. KEATS, M.D.
University of Missouri

Pneumatosis Cystoides Intestinalis. Elaine Epstein. South African M. J. **33:** 911–912, Oct. 31, 1959. (Johannesburg General Hospital, Johannesburg, Union of South Africa)

Pneumatosis cystoides intestinalis is characterized by serous, subserous, and submucous gas cysts occurring anywhere between the stomach and rectum but mainly in the cecum and terminal colon. The complications that may occur are pneumoperitoneum, chronic constipation, intestinal obstruction, and volvulus or adhesions. Plain roentgenograms of the abdomen demonstrate scattered rounded translucent areas which bear some relation to the bowel wall but do not contain fluid levels. A barium meal and enema will show multiple polyp-like filling defects of the bowel lumen, with the bowel wall outlined by translucent gas-filled cysts producing a scalloped margin.

The author reports a case which is unusual in that the gas cysts were mainly confined to the sigmoid colon. Although pneumoperitoneum had been discovered in 1955, the diagnosis of pneumatosis cystoides intestinalis became apparent only on barium enema examination in 1959. Differentiation from multiple polyposis was

based on the following features: (1) the greater radiolucency of the filling defects in the barium column as compared with the soft-tissue density of polypi or other tumors, the cysts having the same radiolucency as the air which was used as a medium for the double-contrast enema study; (2) the change in the shape and size of the cysts, with flattening of the base, when the bowel was distended; (3) extension well beyond the barium enema column of a portion of the translucent defect, due to localization of cysts within the bowel wall.

One roentgenogram.

Visualization of the Pancreas by Aortography. William S. McCune and William W. Stanbro. Ann. Surg. **150:** 561–566, October 1959. (George Washington University School of Medicine, Washington, D. C.)

Contrast visualization of the pancreas was accomplished in dogs by intra-aortic instillation of 5 to 35 units of trypsin, immediately followed by the injection of 1 c.c. of 90 per cent Hypaque per kilogram of body weight. The authors first utilized the pancreaticoduodenal artery and then the upper abdominal aorta as the site of injection.

Without the prior administration of trypsin, injection of Hypaque produced only an arteriogram of the pancreatic vessels. Following trypsin, contrast injection yielded diffuse pancreatic opacification. The dogs were pretreated with 35 units of Secretin to increase pancreatic blood flow, Pyribenzamine to combat the histamine-like effects of trypsin, and propylthiouracil to protect against pancreatitis. The best visualization of the pancreas was at forty-five seconds and ten minutes after injection of the contrast medium.

Of 16 dogs injected, 1 died of peritonitis, assumed to be secondary to pancreatitis. Some opacification of the pancreas was obtained in 70 per cent of the animals. Serum amylase determinations and pathologic study of the pancreas showed no evidence of pancreatitis.

Five roentgenograms; 1 photograph; 1 diagram.

RICHARD H. GREENSPAN, M.D.
New Haven, Conn.

Diaphragmatic Changes Incident to Hepatic Neoplasms. Bernard S. Epstein. Am. J. Roentgenol. **82:** 114–119, July 1959. (270–05 76th Ave., New Hyde Park, N. Y.)

The author describes his observations in 25 patients with liver metastases identified roentgenologically and confirmed at operation and/or necropsy. Three cases are reported in detail. Twelve patients were women. All were from forty to seventy-five years of age. The primary tumor was in the gastrointestinal tract in 10 patients, in the breast in 6, and in the gallbladder in 3. Two patients had hepatomas, and neoplasms of the ovary, uterus, and pancreas were encountered in 1 patient each. In 1 patient, the primary tumor could not be found.

Physical examination revealed marked hepatomegaly in 9 patients; in 10 others the liver edge was palpated from one to four fingerbreadths beneath the right costal arch. In the remaining 6 the existence of hepatomegaly could not be established clinically.

Roentgen investigation included fluoroscopic and roentgenographic studies of the chest and roentgen kymographic examination of the diaphragm. Chest roentgenograms were obtained at midinspiration. In 5 patients the right diaphragm was higher than the left by from 1 to 2 cm.; in 3 of these both sides were elevated. In 8 the dome on the right was from 2 to 4 cm. higher than that on the left and in 12 it was from 4 to 6 cm. higher. The elevated right diaphragm presented a bulging appearance, with the lateral aspect elevated. The right costophrenic sinus was shorter than the left in 18 patients, and either equal or somewhat deeper than the left in 7. Elevation of the right diaphragm was not accompanied by pulmonary or pleural changes in 22 patients; in the remaining 3 there was a slight pleural reaction, and 2 of these had concomitant right lower lobe metastases.

The respiratory range of the diaphragm was studied fluoroscopically and by roentgen kymography. The roentgen kymograms recorded from 1 to 3 respiratory excursions with moderately forced breathing over a three-second period. Inasmuch as fluoroscopic notes are quite subjective and kymograms are completely objective, the latter procedure is held to be more accurate even though it is recognized that careful fluoroscopy may be equally reliable for estimating the range of diaphragmatic movement. Normally the right diaphragm often is slightly higher than the left and its motion somewhat less. For this reason elevation of the right diaphragm up to about 2.5 cm. above the left and restriction of motion of less than 25 per cent were regarded as of doubtful significance. When the right diaphragm was from 3 to 5 cm. above the left and its motion restricted 50 per cent or more, the possibility of underlying hepatic metastases was suggested. Impairment of motion and elevation of both sides of the diaphragm should be considered suggestive of a lesion of sufficient size to produce this change.

The liver was inspected at operation in 19 cases, and the presence of an enlarged or nodular liver due to hepatic metastases was verified, but invasion of the capsule of Glisson and the diaphragm could not be established with certainty. Liver weights in 9 patients in whom necropsy was performed ranged from 2,000 to 4,000 gm. It is concluded that elevation and impairment of movement of the right diaphragm may be produced by hepatic metastases of sufficient bulk, particularly when the dome of the liver is affected. The apparent size of the liver as palpated through the abdomen may not correspond with its actual size, especially when the dome is predominantly involved. Such a change is associated in an appreciable number of patients with a bulging upward convexity of the right diaphragm and restriction of its motion. Pleural or pulmonary reactive changes are infrequent in these patients.

Eleven roentgenograms; 3 photographs.

Recent Advances in Roentgenology of the Biliary System. Lester W. Paul. Missouri Med. **56:** 1123–1126, October 1959. (University Hospitals, Madison 6, Wisc.)

The author first reviews the progress made in roentgenology of the biliary system since Graham and Cole's earliest demonstration of the gallbladder in 1924. An evaluation is made of the procedures currently available for investigation of the gallbladder and biliary ducts with the following conclusions:

(1) If the gallbladder is present and the patient is not jaundiced, the initial examination should be oral cholecystography with Telepaque or a similar medium. Failure to visualize the gallbladder after a 3-gram dose, if extraneous factors can be excluded, indicates disease in 96 to 98 per cent of the patients. In equivocal cases it may be advantageous to repeat the test the following

day with double the amount of medium, but there is need for caution in interpretation of the result with larger doses.

(2) An alternative procedure is to follow the oral test by intravenous administration of Cholografin. The results are interpreted with the same care as though a double or triple dose of Telepaque had been employed.

(3) If the gallbladder has been removed, the investigation is usually begun with Cholografin, although it is possible to opacify the common duct with large doses of Telepaque, orally.

(4) In the jaundiced patient the technic described by Salzman *et al.* (J.A.M.A. **169:** 334, 1959. Abst. in Radiology **73:** 814, 1959) is of value. They found that when Telepaque was given for a period of four days in daily doses of 3 grams (1 gram 3 times daily), roentgenograms obtained on the fifth day showed opacification of the periphery of stones within the common duct or gallbladder which had not been visible previously.

No simple method for routine opacification of the liver is available. All technics making the liver parenchyma opaque depend upon the introduction of contrast material into the blood stream or directly into the vessels of the liver, as in aortography or splenoportography. These procedures require skilled personnel and most of them demand special radiographic equipment for the making of rapid serial exposures. They are, therefore, unlikely to be widely used in routine investigation of the biliary system.

A New Oral Cholecystographic Medium. S. G. Bluestein. J. M. Soc. New Jersey **56:** 602–604, October 1959. (591 E. 27th St., Paterson, N. J.)

Three hundred consecutive cases were selected for an evaluation of Orabilex in oral cholecystography. The usual gallbladder routine was followed. Patients were given a fat meal the night before examination. At 8:00 o'clock on the same evening 6 capsules of Orabilex were administered with water, followed by fasting until the examination was completed. Two-thirds of the patients took the advised bedtime enema. If visualization was not achieved with a dose of 6 capsules, another 6 were given on the following day and the fat-free diet was continued throughout the entire examination. Prone, postero-anterior, and oblique films were obtained, as well as spot-films with compression, in the upright position. All stones seen on spot-films were also observed on regular roentgenograms.

There was excellent or good visualization in 80 per cent of the examinations and, in 11 per cent of these, stones were revealed. Unsatisfactory or nonvisualization led to a diagnosis of pathological gallbladder in 20 per cent of the cases; stones were demonstrated in 45 per cent of these.

Twenty-one (7 per cent) of the patients had reactions, over half of which could be classified as mild. In no instance was it necessary to discontinue the examination for this reason, although one-third of those with reactions complained of severe nausea.

In 48 cases (16 per cent) residual medium was observed in the intestinal tract, but in 87 per cent of these was considered to be of minimal intensity. In no instance did it interfere with the examination.

The author's experience has led him to believe that Orabilex is the best medium now available for oral cholecystography.

Three tables.

Preliminary Experiences with Peroral Cholegraphy. Georg-Fredrik Saltzman. Acta radiol. **52:** 282–288, October 1959. (Serafimerlasarettet, Stockholm, Sweden)

Oral Cholegraphy. Eric Gunnarson. Acta radiol. **52:** 289–296, October 1959. (University Hospital. Lund, Sweden)

Oral Cholegraphy with Bilijodon-Natrium Capsules. An Analysis of 96 Cases. Pekka Virtama. Acta radiol. **52:** 308–314, October 1959. (University Central Hospital, Helsinki, Finland).

Preliminary studies in oral cholegraphy with Bilijodon-Natrium are reported from three Scandinavian hospitals. This substance has recently been introduced by A. B. Leo Company, Hälsingborg, Sweden. It is supplied in 50 per cent concentration in gelatine capsules.

Bilijodon-Natrium is a water-soluble agent, the sodium salt of iopanoic acid (Telepaque). Its advantages include a smaller undissolved residue in the intestine, greater absorbability, better visualization of the bile ducts, and rapid examination.

Gunnarson began using Bilijodon-Natrium in 1955, first giving the substance by direct instillation *via* a duodenal tube. Later the agent was administered in capsule form, dissolved in polyvalent alcohols. In 116 patients, representing both methods of administration, good definition of the bile ducts was obtained in 80 cases and faint visualization in 22 cases.

Virtama reports 96 cases in which Bilijodon-Natrium was used in the capsule form. His method of examination is the same as that of Gunnarson: The dose is 1 gram per 20 kg. body weight, with 150–500 c.c. distilled water. The patient is placed in the right decubitus position for about one hour. Films are taken at 45, 60, 90, 120, 180, and 240 minutes.

The gallbladder and main bile ducts were well filled in 40 per cent of the patients after two hours. Good visualization of the gallbladder and ducts was obtained in over two thirds of the series. Among 24 patients who had nonfilling of the biliary system with Telepaque, good or moderate filling of the gallbladder was achieved with Bilijodon-Natrium in 13, while the bile ducts were visualized in 10.

Side effects with Bilijodon-Natrium are similar to those with iopanoic acid—nausea and diarrhea of mild transient nature.

The three authors all conclude that Bilijodon-Natrium is an effective oral medium for cholegraphic study. It is recommended in cases of nonvisualization of the biliary system with Telepaque and in patients who may be allergic to intravenous iodine substances. Additional clinical studies will be necessary to evaluate the merits of the medium more fully. [This sodium salt of iopanoic acid has not been offered commercially in the United States.]

CAPT. ALLAN E. GEEEN, Jr., M.C.
Lackland AFB, Texas

Contrast Medium Precipitate in the Human Gallbladder. Georg Theander. Acta radiol. **52:** 297–307, October 1959. (Malmö Allmannä Sjukhus, Malmö, Sweden)

Eight cases are reported in which a precipitate of contrast medium occurred in the gallbladder at oral cholecystography. The contrast agent in all cases was the sodium salt of iopanoic acid, Bilijodon–Natrium (see above). Similar cases have been recorded previ-

ously with iopanoic acid (Telepaque). The precipitate appeared as a dense, curvilinear shadow along the gallbladder wall, usually in the fundus, persisting on serial roentgenograms for several days; in one case, precipitate was seen one month after oral intake of the agent.

All patients were symptomatic at the time of cholecystography. Six exhibited calculi and in 2 the gallbladder was poorly visualized. In 2 patients undergoing cholecystectomy, calculi were found, but no bile or gallbladder wall abnormalities could be demonstrated.

The author discusses several theoretical approaches to the production of this unusual occurrence. The precipitation of contrast medium may explain the opaque coating of gallstones after prolonged administration of iopanoic acid, the "rim sign" of Salzman and Warden (Radiology **71**: 85, 1958).

Twenty-two roentgenograms.

CAPT. ALLEN E. GREEN, JR., M.C.
Lackland AFB, Texas

The Radiological Diagnosis of the Blocked Gall-Bladder. Eric Samuel and A. Berezowski. South African M. J. **33**: 897–899, Oct. 24, 1959. (Royal Infirmary, Edinburgh, Scotland)

Intravenous cholangiography with Biligrafin or Biligrafin Forte provides a method of detecting obstructions in the cystic duct and its value in the differential diagnosis of gallbladder lesions in acute abdominal conditions is emphasized.

In the so-called "acute abdomen," failure of the gallbladder to fill when the liver excretes the medium normally into a normal duct system implies gallbladder and cystic-duct disease. In the acute case, however, it must be admitted that the obstruction in the cystic duct is not necessarily due to stones; it may be caused by pus, inflammatory exudate, or even edema of the mucosa of the cystic duct.

The authors follow a definite routine in investigating upper abdominal pain of possible gallbladder origin. Unless acute symptoms are present, oral cholecystography is first performed. If this fails to demonstrate a gallbladder shadow, intravenous cholangiography follows at once. Anatomical lesions in the biliary tree and in the cystic duct are immediately detected by this method. In some cases of cholecystitis the excretion of the contrast medium by the liver is delayed, and the shadows of the extrahepatic biliary tree are not visualized for an hour after injection. The examination is continued up to six hours after the injection (except in the acute case), as in some instances a gallbladder shadow has first been observed at that time. Failure of visualization of the gallbladder by the intravenous method does not necessarily mean complete obstruction, however; in 1 such case a normally functioning gallbladder was found six months later.

Cholangiographic and operative findings are compared in 9 cases with the following diagnoses: (1) acute cholecystitis with stone in the cystic duct; (2) chronic cholecystitis with numerous stones in the gallbladder and common bile duct; (3) multiple calculi with a large calculus lodged in Hartmann's pouch; (4) cystic duct obstructed by inspissated pus and edema and gallbladder thickened and fibrosed; (5) empyema of the gallbladder with a stone in the cystic duct and several stones in the gallbladder; (6) acute cholecystitis with four large stones in the gallbladder, one being lodged in Hartmann's pouch, obstructing the neck of the gallbladder; (7) a large, distended, pus-filled gallbladder with a single cholesterol stone in Hartmann's pouch; (8) a grossly thickened and distended gallbladder with a solitary stone in Hartmann's pouch; (9) empyema of the gallbladder with 2 large gallstones, 1 of which was impacted in Hartmann's pouch.

Two figures.

Spontaneous Disappearance of Gallstones. Joseph F. Linsman and Eliot Corday. J.A.M.A. **171**: 1098–1100, Oct. 24, 1959. (College of Medical Evangelists, Los Angeles, Calif.)

An unusual case of spontaneous disappearance of 10 lucent gallstones from the gallbladder is reported. There was no history of colic, jaundice, or other abdominal crisis. As originally demonstrated roentgenographically, the stones measured 7 to 9 mm. in diameter. Cholecystograms four years later were entirely normal. The authors cite other similar reports.

Four roentgenograms.

WILLIAM MARTEL, M.D.
Ann Arbor, Mich.

Operative Cholangiography. Eric Samuel. Brit. J. Radiol. **32**: 669–672, October 1959. (Royal Infirmary, Edinburgh, Scotland)

The author mentions the following objections which have been made to operative cholangiography: that it lengthens the time of operation and complicates the technic; that air bubbles produce artefacts; that complications may follow the use of the contrast medium. Modern radiographic technics have overcome these difficulties.

A special cassette tunnel is described through which cassettes can be slid into position for exposure on a linen runner. The tunnel, which exactly fits the operating table, is lead-protected on its upper surface except for a Perspex window measuring 12 × 10 inches. Six cassettes are contained in six pockets in the runner, which is withdrawn to bring the films successively beneath the Perspex opening.

Insertion of a polythene catheter into the cystic duct is the method of choice for injection of the opaque medium. The cystic duct is isolated, the injection is made, the films are exposed and then are developed during the removal of the gallbladder.

The introduction of air bubbles which may cause artefacts simulating stones can be avoided by use of a special gasket connection to the polythene tube. The tube varies in length, but is long enough so that the surgeon is well out of the field of radiation.

Ten cubic centimeters of water-soluble contrast medium are injected and films are made as each 2.5 c.c. is injected. A differential filling of the duct system avoids overfilling which might obscure small stones.

Chemically induced pancreatitis due to reflux of the contrast medium into the pancreas has been recorded as a complication. The author feels that this can occur only after very forceful injection and with poor technic.

Four roentgenograms; 3 drawings.

R. P. STORRS, M.D.
Los Angeles, Calif.

The Dynamic Variability of the Choledocho-Pancreatico-Duodenal Junction: A Roentgen Cinematographic Investigation. B. Jacobsson, L. O. Lanner, and C. Rådberg. Acta radiol. **52**: 269–281, October 1959. (Sahlgrenska Sjukhuset, University of Gothenburg, Sweden)

Postoperative roentgencinematographic cholangiog-

raphy on 34 patients elucidated the dynamic variability of the choledocho-pancreatico-duodenal junction and its variation both under constant and varying pressure conditions, as well as under the influence of drugs.

The terminal portion of the choledochus was found to vary from one moment to another, depending on the tone of the sphincter muscle. The separate contractions of the choledochus or the pancreatic duct just above the common channel permit separate evacuation of ducts. Under continuous infusion at high pressure, an abundant flow of medium to the intestine and a more marked reflux to the pancreatic duct is observed.

A sudden elevation of the pressure in the choledochus or an injection of morphia provokes increased tone in the sphincter muscles, interrupting the flow to the intestine and the reflux to the pancreatic duct. Administration of nitroglycerine relaxes the sphincter and opens the intramural section of the common duct.

Roentgencinematography also helps differentiate an abrupt or slightly concave termination of the choledochus due to an increase in sphincter tone from one due to organic cause.

Thirty roentgenograms; 1 drawing.

CAPT. SAMUEL S. KRIKORIAN, M.C.
Lackland AFB, Texas

The Radiological Demonstration of the Common Bile-Duct Terminating in a Duodenal Diverticulum of the Papillary Region. Report on 4 Cases. J. Munk. J. Fac. Radiologists **10**: 213–218, October 1959. (Ramham Government Hospital, Haifa, Israel)

There are presented 4 cases with radiologic visualization of a common bile duct terminating in a duodenal diverticulum of the papillary region. The author discusses the pathogenesis of this type of duodenal diverticulum, in which the ampulla of Vater is situated within the diverticular wall. The view is put forward that these are true diverticula representing congenital malformations.

An evaluation of the clinical significance of this condition suggests that it represents a predisposing factor for biliary-pancreatic disease and possibly for stone formation in the common bile duct. Incompetence of the sphincter of Oddi is believed to be a common feature or even part of the anomaly.

The importance of the preoperative radiological demonstration of this condition, at as early a stage as possible, is stressed. The value of the radiological methods available for the purpose (gastroduodenal barium examination; intravenous cholangiography; operative cholangiography) is discussed. Postoperative cholangiography shows the condition conclusively, but earlier diagnosis is desirable. A few indirect radiological signs which point to the presence of the condition are described: The diverticulum is usually situated in the axis of the common bile duct, the greater part being to the left of the terminal portion of the duct. This part of the duct usually turns to the left, toward the base of the diverticulum. Demonstration of the site of the major papilla is of conclusive significance.

One of the author's cases is believed to be the first on record in which the ending of the common duct within a diverticulum of the papillary region has been demonstrated by intravenous cholangiography (Biligrafin).

Nine roentgenograms.

THEODORE E. KEATS, M.D.
University of Missouri

THE MUSCULOSKELETAL SYSTEM

Arteriography and Osteomedullography in the Diagnosis of Bone Tumors. A. Ratti. Radiol. clin. **28**: 263–275, September 1959. (In Italian) (Istituto di radiologia, Università di Milano, Milan, Italy)

In general, arteriography is useful in those bone lesions originating in the cortex, periosteum, and parosteal tissues, whereas medullography is more suitable for lesions in the medulla.

Arteriography may help to resolve the problem whether the process is inflammatory or neoplastic, and, in the latter case, benign or malignant. It can give more precise data on the extension of malignant tumors than are otherwise attainable.

The essential diagnostic elements in arteriography are: an irregular arterial rete formed by vessels of irregular caliber and course; vascular pools with slowed circulation; diffusion of opacified blood in the mass; early appearance of a venous phase (arteriovenous shunts). Benign tumors are characterized by mechanical dislocation of vessels which tend to surround the tumor, but the vessels themselves are not abnormal.

Any pathologic process involving the medulla is an obstacle to the endosteal venous flow, resulting in a simple deviation of the normal flow, with all variations in rate from mere slowing to complete block.

Thirteen roentgenograms; 2 diagrams.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Osteochondrodystrophy (Morquio's Disease) in Three Generations. J. J. P. Lomas and A. C. Boyle. Lancet **2**: 430–432, Sept. 26, 1959. (Middlesex Hospital, London, W. 1, England)

Osteochondrodystrophy (Morquio's disease) is a developmental defect of the skeleton which may result in almost complete arrest, or any degree of partial arrest, of ossification of cartilage. The whole skeleton may be affected to a variable degree with the exception of the skull and face, which remain normal. Over 100 cases have been reported, mostly isolated or in siblings. After encountering 1 case, the authors made a clinical and radiologic study of 75 of 79 members in three generations of the patient's family. X-ray examination of the hands, vertebral column, and pelvis disclosed osteochondrodystrophy in 31, 18 females and 13 males. This was of all grades, from minor changes involving only the metacarpals, the phalanges, or an isolated vertebra, to the florid picture described by Morquio. Changes in the fourth and fifth metacarpals were the commonest stigmata, and radiography of the hands is suggested as a screening test.

The abnormality is transmitted as a mendelian recessive factor to both sexes. In the family described here all members of the first generation, 55 per cent in the second generation, and 22 per cent in the third were affected. None of those with minor involvement transmitted the condition, which thus tended to die out in succeeding generations.

Six roentgenograms; 1 chart; 1 table.

A Case of Congenital Osteogenesis Imperfecta Visible on Prenatal X-Ray. W. Jonas. J. Obst. & Gynaec. Brit. Emp. **66**: 485–486, June 1959. (London, England)

The author reports a case of congenital osteogenesis imperfecta recognized *in utero*. A roentgenogram of

the mother taken three weeks before term revealed a single fetus in breech presentation. On first impression the size of the fetus suggested a pregnancy of about thirty-two weeks, because the bones were still very small and radiolucent. Most of the lower extremities were obscured by the mother's sacrum. One femur, however, was clearly visible; it appeared short, plump, and irregularly outlined and contained at least three fractures. There also seemed to be a fracture in one humerus and perhaps one in the ulna on the same side. The smallness of the bones, lack of calcium, general appearance of one femur, and the multiple fractures were suggestive of osteogenesis imperfecta. A further remarkable feature was the Buddha attitude of the fetus sometimes seen in roentgenograms of hydrops fetalis. Roentgen examination of the infant on the second day of life confirmed the prenatal diagnosis of osteogenesis imperfecta.

Two roentgenograms.

Primary Hyperparathyroidism and Secondary Renal Failure with Osteosclerosis. B. Beveridge, B. F. Vaughan, and M. N. I. Walters. J. Fac. Radiologists **10:** 197–200, October 1959. (University of Western Australia, Perth, Australia)

The authors present a case of parathyroid adenoma, proved at autopsy, with development of secondary renal failure and osteosclerosis.

The patient was a 63-year-old woman with a history of renal calculi. Radiographic examination showed subperiosteal erosions in the phalanges and generalized osteosclerosis, as well as marked arterial calcification. The vault of the skull was thickened. In some bones, there was a mixture of sclerosis and osteoporosis.

The main biochemical features were an increase in serum calcium, serum phosphate at the upper limit of normal, normal urinary calcium excretion, and consistently low normal urinary phosphate excretion. In addition, there was a consistently low serum bicarbonate, high serum chloride, and a rising blood urea—the picture of hyperchloremic acidosis. The urinary amino-acid, nitrogen content, and electrophoretic pattern were normal.

Increased bone density associated with renal failure has been described previously, but this is apparently the first report of such osteosclerosis in a patient with primary hyperparathyroidism.

Six roentgenograms; 1 photograph; 1 table.

THEODORE E. KEATS, M.D.
University of Missouri

Bone Changes in Adult Cretins. I. B. D. Middlemass. Brit. J. Radiol. **32:** 685–688, October 1959. (Royal Infirmary, Dundee, Scotland)

Observations were made on 32 adult cretins, including 20 females and 12 males, with particular reference to x-ray findings in the skull, lumbar spine, hips, and wrists.

The radiographic changes observed represent the end-results of abnormalities which are more familiar in infancy and childhood and have little practical value in diagnosis. They do show, however, the skeletal effects of prolonged thyroid hormone deficiency.

Twelve of the patients exhibited no abnormality other than small bone structure. In the others various changes were observed, such as underdevelopment of accessory nasal sinuses, thickening of the cranial vault, slight pituitary fossa enlargement, anterior wedging of the last dorsal or first lumbar vertebral bodies, flattening of the femoral heads, and delayed skeletal maturation. Eleven showed no more than one of the changes described; in 9 there were multiple abnormalities.

Persistence into adult life of the signs of epiphyseal dysgenesis in the thoracolumbar spine region was noted in only 4 patients. This the author regards as surprising in view of the high incidence in infants and children. All subjects with a large sella turcica had multiple abnormalities, but no particular pattern was discernible.

Six roentgenograms. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Radiological Aspects of Caisson Disease. André M. Fournier and Georges Jullien. J. de radiol. **40:** 529–534, October 1959. (In French) (Marseilles, France)

The radiologic findings in caisson disease are of four types: osseous rarefaction, manifested by areas of demineralization without clear limits or by circular or oval radiolucencies; osseous condensation, compact or trabeculated; sequestration; and mixed pictures. These appearances are described and illustrated with 17 roentgenograms. RENÉ HOURI, M.D.
New York, N.Y.

Radiologic Aspects of Some Sternal Lesions. Y. Saudan. Radiol. clin. **28:** 313–319, September 1959. (In French) (Policlinique médicale universitaire, Lausanne, Switzerland)

Radiology of the sternum receives scant attention in the literature, probably as a result of its technical difficulty. The author uses four types of examination: (1) lateral roentgenography, as for the lungs; (2) contact radiography with double exposure; (3) oblique view made under fluoroscopic control with the patient upright; (4) tomography. His cases include 2 malformations, 1 fracture-luxation, 8 osseous metastases, of which 5 originated in the breast, 1 case of sternoclavicular arthrosis, and 7 inflammatory lesions.

The conclusion is reached that it is impossible to obtain on one film a satisfactory image of the entire sternum. The radiologic procedures should be chosen according to the localization and suspected nature of the lesion. Thus, for the manubrium and the sternoclavicular region, contact and oblique studies are used; for the superior sternal articulation, standard lateral and frontal views and lateral tomography; for the body of the sternum, oblique views and tomography. If one is looking for diffuse changes, oblique radiography is preferable to tomography, since the latter tends to efface detail.

Five roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Significance of Single Large Films of the Entire Spine for the Diagnosis of Spinal Disease. W. Leger. Radiol. clin. **28:** 129–138, May 1959. (In German) (Orthopädische Universitätsklinik, Cologne-Lindenthal, Germany)

The author reviews the technic of taking 30 × 90-cm. films of the entire spine at a distance of 3.0 meters. The use of diaphragms is necessary and good immobilization of the patient is esssential. Examination of the entire spine with a single upright film in the sagittal and lateral projections is an important addition to the diagnosis of spinal lesions. Sagittal films are obtained more easily than lateral views. The anteroposterior

view demonstrates lateral deviations of the spine from the head to the pelvis, which is important in the treatment of scoliosis. The lateral view shows the static build-up of the spine, especially in relation to the pelvis and hip joints, as well as the lumbosacral region and the spinal curvatures.

Eight roentgenograms.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

Transitory Demineralization of the Hip in Pregnancy: A Report of Three Cases. Paul H. Curtiss, Jr., and William E. Kincaid. J. Bone & Joint Surg. **41-A:** 1327–1333, October 1959. (2065 Adelbert Road, Cleveland 6, Ohio)

Three cases are presented in which pain of varying severity in one or both hips or thighs developed in the last trimester of pregnancy, associated with the roentgen demonstration of spotty demineralization. The demineralized areas, showing sharply localized margins, involved one or both femoral heads, a small part of the femoral neck, and the acetabulum. A return to normal, both clinically and roentgenographically, occurred within several months after delivery. Each of the patients had spina bifida occulta of the first sacral segment, but the authors consider this finding to be coincidental. The cause of the syndrome is unknown but it may be of neurogenic origin.

Six roentgenograms.

HOWARD J. BARNHARD, M.D.
Philadelphia, Penna.

X-Ray Control for Operations on the Hip. I. William Nachlas and James R. Feldman. J. Bone & Joint Surg. **41-A:** 1339–1341, October 1959. (J. R. F., Sinai Hospital, Baltimore, Md.)

In an attempt to overcome the difficulties of obtaining lateral roentgenograms of the hip during operations, the authors have perfected an apparatus, which they describe. It consists basically of two parallel bars on which are placed movable units for (*a*) holding the film, (*b*) positioning the apparatus beneath the symphysis, and (*c*) directing the x-ray beam. The unit is set up prior to the operation, and the cassettes can be changed without disturbing the surgical field. It results in standardization of technical factors and reduction in irradiation to personnel, since the cassette need not be hand held.

One roentgenogram; 5 photographs.

HOWARD J. BARNHARD, M.D.
Philadelphia, Penna.

Arthrography in the Diagnosis of Meniscal Injuries of the Knee: A Correlation of the Roentgenographic, Clinical, and Operative Findings. Vernon C. Turner and Flora Brown Wurtz. J. Bone & Joint Surg. **41-A:** 1213–1219, October 1959. (636 Church St., Evanston, Ill.)

The authors have performed 469 arthrographic examinations; 188 cases in which the procedure was done for the diagnosis of meniscal injuries are analyzed. The medium employed was Diodrast 35 per cent, which is water-soluble, miscible with the joint fluid and, unlike air, can be used in the presence of joint effusion. The method is given in some detail. Ten to fifteen cubic centimeters of the Diodrast solution is injected. The only absolute contraindication is infection in or around the joint. In addition, the examination is likely to be unsatisfactory if there is marked degenerative arthritis or inability to extend the knee to at least 170°.

The method is much less valuable in the diagnosis of lesions of the lateral meniscus than of the medial. In the latter group the accuracy varied from 72 per cent in those with an atypical clinical picture to 90 per cent when the history and clinical findings were typical of a meniscal tear.

The procedure is time-consuming and therefore expensive. It should not be done where the diagnosis is fairly certain from other means of examination.

One roentgenogram; 2 tables.

HOWARD J. BARNHARD, M.D.
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Endocrine Significance of Short Metacarpals. R. M. Archibald, N. Finby, and F. De Vito. J. Clin. Endocrinol. **19:** 1312–1322, October 1959. (Rockefeller Institute, New York, N. Y.)

When a line drawn on a roentgenogram of the human hand tangentially to the circumference of the fourth and fifth metacarpals is extended, it usually passes distal to the head of the third metacarpal. As a result of deviation from the average of the relative lengths of the metacarpals, however, such a line may instead pass through or tangential to the head of the third metacarpal, in the former case constituting the so-called metacarpal sign, in the latter indicating a borderline relationship.

Observations on 2,594 patients who attended the outpatient department of the child growth-study and endocrine clinics of the Rockefeller Hospital seemed to indicate that a borderline or positive metacarpal sign is of frequent occurrence in patients with gonadal dysgenesis having either male or female sex chromatin.

The incidence of borderline or positive findings was approximately 8 per cent, with no significant difference between the sexes. Borderline findings occurred with equal frequency in either hand. Positive findings were more frequent in the left hand, and it was felt by the authors that this was not the result of hand dominance.

In males, metacarpal findings were usually associated with testicular atrophy, delayed sexual maturation, or delayed testicular descent. However, none of 5 cases of Klinefelter's syndrome (all with female sex chromatin) exhibited any unusual metacarpal findings.

When the metacarpal sign is detectable in more than one generation of the same family, no endocrine significance is attached to it. When, however, it is found in only one generation, the chances of there being some aberration of the gonads is very high.

Patients with the metacarpal sign tend to be of short stature for their chronologic age.

The development of the metacarpal sign appears to be related to a more rapid growth of the third and fifth metacarpals, especially the latter (relative to the fourth), than occurs normally.

Short metacarpals have also been observed in melorheostosis, ectodermal chondrodysplasia, Morquio-Brailsford's type of chrondrodysplasia, epilepsy, pseudohypoparathyroidism, and rheumatoid arthritis.

Because of the many skeletal and other congenital anomalies found in patients with gonadal dysgenesis, it might be assumed that the metacarpal sign is merely another skeletal anomaly. However, its occurrence in males with marked gonadal involvement is not asso-

ciated with any congenital skeletal abnormalities which have yet been recognized.

Four roentgenograms; 5 tables.

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THE SPINAL CORD

Intradural Arachnoid Cyst of the Lumbar Spinal Canal. R. O. Murray. Brit. J. Radiol. **32:** 689–692, October 1959. (Royal National Orthopaedic Hospital, London, England)

Diverticula of the arachnoid membrane may give rise to either extradural or intradural spinal cysts depending upon whether or not the diverticulum passes through a defect in the dura mater. In most of the cases of arachnoid cyst reported in the literature the cyst was of the extradural type. The majority have involved the thoracic spine.

The radiologic findings are those of a space-occupying lesion within the neural canal, namely, resorption of the surrounding bony structures as a result of long-continued pressure. In anteroposterior projections the pedicles show thinning as a result of erosion of the inner margins. In lateral projections the density of the affected pedicles is reduced and scalloping of the posterior aspects of the vertebral bodies in contact with the lesion may be seen. Lumbar myelography commonly reveals a block at the lower level of the obstruction. Opaque medium may actually enter the cyst.

A case of a large intradural arachnoid cyst is reported in which plain films revealed erosion of the medial aspects of the pedicles of T-12 to L-3 and scalloping of the posterior aspects of these vertebral bodies. Myelographic study showed partial obstruction to the flow of opaque medium at each intervertebral level from L-3 to T-11 with a tendency to pooling of the medium opposite each vertebral body level in the area of scalloping.

These lesions may produce a clinical picture simulating lumbar or lumbosacral disk protrusion. Adequate myelographic study is of extreme importance in making the diagnosis, since neurosurgery offers a prompt and lasting cure.

Six roentgenograms.

R. P. STORRS, M.D.
Los Angeles, Calif.

Contrast-Medium Injury to the Spinal Cord. The Role of Altered Circulatory Dynamics. G. Margolis, A. T. Griffin, P. D. Kenan, G. T. Tindall, R. Riggins, and L. Fort. J. Neurosurg. **16:** 390–406, July 1959. (A. T. G., Duke University Medical Center, Durham, N. C.)

The pathogenesis of vascular injury to the central nervous system by contrast media was studied in 75 adult mongrel dogs. Urokon was introduced *via* retrograde intra-aortic injection and a fluorescent indicator technic was used to observe the effects of this substance upon the circulatory dynamics of the cord. For more detailed information concerning the experimental procedures, the original article should be consulted.

Circulatory Effects of 35 per cent Urokon: Following injection of 35 per cent (1 c.c. per kg.) Urokon, a striking increase in rate of blood flow of the spinal cord occurred, persisting from ten to thirty minutes in individual animals. A 10 to 20-mm. Hg rise in aortic pressure immediately followed by a drop of 30 to 40 mm. Hg below the preinjection level coincided with injection of the medium into the aorta. A return to normal pressure occurred in one or two minutes. Vascular permeability barriers of the cord remained intact during and following circulation of the 35 per cent Urokon, and there was no parenchymal fluorescence in cords sectioned at the termination of the experiment.

Circulatory Effects of 70 Per Cent Urokon: Seventy per cent Urokon exerted a manifestly toxic action when administered to animals in the supine position. The effect was less clearly toxic upon dogs in the prone position. In the supine position, spinal convulsions occurred when the injection mass reached the pial vessels (unless the animal had been adequately dosed with Anectine). After the pial vessels filled, there was arrest in flow of the contrast agent, lasting from forty to one hundred twenty seconds. The contrast medium remained in the arterial tree for ten to thirty seconds and then slowly disappeared from the venous bed. As the vascular network filled, multiple focal extravasations developed about the pial veins and spread slowly into the subarachnoid space. At the same time, fixed foci of fluorescence appeared in the marginal zones of the parenchyma of the cord and remained several minutes after decay of vascular fluorescence.

Almost immediately following injection, clumping of red cells into granular masses occurred, more prominent in the venous than in the arterial network. Flow of blood was remarkably slowed, and in some vessels showed irregular reversal of direction. Vasodilatation, rather than vasoconstriction, was a prominent feature of the reaction. Following this vasotoxic reaction, there was extravasation of material into the cord and cerebrospinal fluid. The circulatory status of the cord commonly progressively deteriorated during the period of observation. In a few dogs the apparent shutdown of injured vascular pathways abated in fifteen to thirty minutes.

In dogs in the prone position, the action of 70 per cent Urokon was far less toxic. The arterial exposure period was prolonged to eight to fourteen seconds and regional venous exposure was prolonged to as much as twenty-five seconds. This delayed circulation was not associated with breaks in vascular permeability barriers, nor was it followed by the state of resistance to perfusion which characterized the vasotoxic reaction described above. In the post-injection state there was an acceleration of circulation time identical with that following lower concentrations of contrast agent.

Whether or not overt toxic manifestations were produced by 70 per cent Urokon, a transient rise of 10 to 20 mm. Hg in intra-aortic pressure was observed, followed immediately by a fall of 50 to 60 mm. Hg in systolic pressure. This hypotensive action persisted for seven or eight minutes, with a gradual return to normal.

In an addendum, the authors mention two recently published papers on the circulatory effects of contrast agents reporting results entirely consistent with their own findings and interpretations (Lindgren and Törnell: Acta radiol. **49:** 425, 1958. Abst. in Radiology **72:** 612, 1959; Kågström, Lindgren, and Törnell: Acta radiol. **50:** 151, 1958. Abst. in Radiology **72:** 773, 1959).

Seven graphs.

SAMUEL B. HAVESON, M.D.
Lynwood, Calif.

GYNECOLOGY AND OBSTETRICS

The Cervix in Hysterosalpingography. H. E. Reiss. J. Obst. & Gynaec. Brit. Emp. **66:** 317–318, April 1959. (University College Hospital, London, England)

It is now recognized that the cervix is not merely a

rigid canal, but a dynamic structure with a functioning sphincter at the level of the internal os. The chief drawback of the type of cannula usually employed in hysterosalpingography is that the tip enters the cervical canal for an appreciable distance and obscures its outline. Furthermore, technics which allow the tip to pass through the isthmus may give a misleading impression of this region. The author describes a short-tip cannula which he believes to be more practical. With its use, satisfactory roentgenograms of the cervix, uterus, and tubes are obtainable. In cases with tubal obstruction it is occasionally difficult to secure a perfect seal and therefore in cases of subfertility the author continues to employ the traditional rubber olive-tipped cannula. The instrument described, however, is considered ideal for investigation of cases of repeated abortion. With the short-tip cannula, the pain associated with the passage of the traditional type of cannula through the internal os is avoided. Reflux tubal spasm due to endometrial trauma is eliminated. In cases of bicornuate uterus, the confusion caused by passage of the long cannula into one horn only is not encountered.

Six roentgenograms; 1 photograph.

THE GENITOURINARY SYSTEM

Tumors of the Kidney Pelvis. William N. Taylor. J. Urol. **82:** 452–458, October 1959. (Ohio State University College of Medicine, Columbus, Ohio)

The clinical data on 32 cases of carcinoma of the kidney pelvis are reviewed. Three of these cases the author has previously reported (Taylor: J. Urol. **33:** 531, 1935) and 29 represent new cases added to the literature.

The ages of the patients ranged from thirty-two to eighty-one years, although the greatest number were in the fifth, sixth, and seventh decades. The tumors occurred more frequently in males (9 females and 23 males) in a ratio of 1.0 to 2.5. No symptom complex was found to be characteristic. There was gross hematuria in 90.4 per cent, representing the most frequent complaint. The hematuria was intermittent and was observed from six hours to thirteen years before a diagnosis was established. The possibility of these tumors remaining small and bleeding infrequently over long intervals of time before growing rapidly and acquiring invasive characteristics is discussed. Pain was an inconstant factor, varying in intensity, type, and location, depending upon the site of obstruction. It was absent in 14 patients.

The diagnosis of tumor of the renal pelvis is ultimately suggested or established by the finding of filling defects in the pyelograms. The defect may be confined to the renal pelvis without interfering with drainage from any of the pelvic components; it may occlude the ureteropelvic junction or one or more infundibula, resulting in pelvic or calyceal hydronephrosis; or it may arise in a calyx or an infundibulum, completely blocking it, and giving rise to an irregular or distorted hydrocalyx.

Although the pyelographic defects are rarely diagnostic of tumor of the kidney pelvis, their location and outline may suggest this possibility. The outline of the defect is usually irregular. If the contrast medium penetrates between the fronds of a tumor, the pelvis may appear mottled on the pyelogram. Degenerative inflammatory lesions may be suggested by tumors arising from an infundibulum or calyx. Simultaneous intravenous and retrograde studies may delineate a tumor blocking the ureteropelvic junction, or repeated pyelograms may be necessary to demonstrate the constancy of small filling defects. The tumors may be confined to the kidney pelvis or distributed along the ureter and bladder. In this series, approximately one-third of the patients with pelvic tumors also had tumors involving the ureter or bladder.

Nephrectomy with total removal of the ureter is the treatment of choice although the recurrence rate, even with this approach, is 15 per cent. Prognosis of papillary carcinoma of the kidney pelvis is unpredictable but generally poor. There were 31 papillary carcinomas and only one squamous-cell carcinoma in this series. Irrespective of the grade of tumor or the degree of infiltration, only 8 of the 30 patients in whom the primary lesion was studied have survived more than five years.

The importance of postoperative follow-up for recurrent tumor is emphasized, and views on the multicentric origin of these tumors are discussed.

Six roentgenograms; 2 photographs.

H. W. SCOTT, M.D.
University of Pennsylvania

Pyelo-Ureteritis Cystica. A Report of Two Cases. J. A. Veiga-Pires. J. Fac. Radiologists **10:** 207–212, October 1959. (Royal Northern Hospital, Holloway, London, England)

The author describes 2 cases, one of pyelitis cystica and one of pyelo-ureteritis cystica, both diagnosed radiologically. His discussion of the condition is based upon these and 32 cases from the literature. The condition is characterized by small cysts which probably have their origin in an underlying inflammatory process. Lymph stasis may be a contributing factor. The lesions may also involve the fundus and the trigone of the bladder.

On excretory pyelography, renal function will be found to vary with the extent of the disease, the degree of mechanical obstruction, and the severity of infection. When there is some function, quite accurate information is obtainable. Pelvic compression should not be used through the entire examination, since it may produce excessive filling of the ureter and pelvi-calyceal system, possibly obscuring small alterations of outline or any structures protruding into the lumen. For the first and last films of the series compression should probably be omitted.

Retrograde pyelography is the investigation of choice. During the injection of the contrast medium, care should be taken to prevent the passing of air bubbles into the ureter.

The cysts, if widely spaced, produce punched-out defects in the lumen. If they form clusters and are relatively small, they give a ragged appearance, particularly in the ureter. Gross hydronephrosis and hydro-ureter may develop. The radiographic picture may remain unchanged for years. When the condition is advanced, the ureter may appear elongated and sinuous with zones of ring-narrowing alternating with dilatations due to fibrotic changes.

Differential diagnosis includes air bubbles in the renal tract, nonopaque calculi, blood clot, ureteral tuberculosis, and papillomata of the renal pelvis or ureter.

Six roentgenograms; 3 photographs; 3 charts.

THEODORE E. KEATS, M.D.
University of Missouri

MISCELLANEOUS

Radiologic Diagnosis in Abdominal Trauma. J. H. Woodruff, Jr., and J. H. Simonton. California Med. **91:** 197–200, October 1959. (Harbor General Hospital, Torrance, Calif.)

This paper is one of general interest for those desiring basic information on the potentialities of radiologic diagnosis of abdominal trauma. One hundred and ninety-eight cases of penetrating and nonpenetrating abdominal injuries which underwent radiologic investigation are analyzed. The roentgen findings in a multiplicity of lesions are catalogued and briefly described. In the series under study, traumatic damage to the spleen was the most common condition and was found in about one-fourth of the cases. Injuries to the abdominal wall, small intestine, and liver followed closely in frequency of occurrence.

The authors stress the importance of consultation with the radiologist before, during, and after the examination, in order that the most advantageous studies be performed with the least additional trauma to the patient. A few points of interest include the statement that increased and coarsened serrations of the greater curvature of the stomach occurred more frequently in patients with traumatized spleens but were present in a considerable number of apparently normal individuals. The site of visceral fracture, *e.g.*, liver or spleen, may occasionally be recognized by noting an irregularity of the margin of the organ. Damage to the spleen may produce changes in the retroperitoneal structures as well as in the general abdominal cavity.

One table.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

A Case Study of Peculiar Soft-Tissue and Bony Changes in Association with Thyroid Disease. Lionel R. King, Herbert Braunstein, Donald Chambers, and Richard Goldsmith. J. Clin. Endocrinol. **19:** 1323–1330, October 1959. (University of Cincinnati College of Medicine, Cincinnati, Ohio)

The authors describe a case of thyroid acropachy—terminal phalangeal clubbing and periosteal proliferation in the phalanges, metacarpals, or metatarsals, associated with thyroid disease. In this patient marked periorbital edema was also present. These changes occurred following radioactive iodine therapy for classical hyperthyroidism. At that time, the patient was not considered myxedematous and biopsy of the bony and soft-tissue lesions supported this impression.

The literature on thyroid acropachy is reviewed and the findings in 12 previously reported cases are tabulated. It is thought that the anterior pituitary gland plays an important part in the etiology.

Two roentgenograms; 3 photographs; 1 table.

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Electrocardiographic and Radiographic Findings in Acute Arsenic Poisoning. Aristides G. Gousios and Lester Adelson. Am. J. Med. **27:** 659–663, October 1959. (L. A., Western Reserve University School of Medicine, Cleveland, Ohio)

A fatal case of arsenic poisoning is reported. The patient, a 32-year-old Negro, was admitted to the hospital with vague abdominal pain of three weeks duration. In the three days prior to admission the pain had become more severe, and on the day of admission there had developed sharp, crampy epigastric pain radiating to the lower part of the abdomen. Vomitus consisted of blood-tinged, brown material. There was no history of peptic ulcer, and both the patient and his wife denied having eaten canned or "left-over" food or having been exposed to poisons. The abdomen was "board-like" and diffusely tender, with hypoactive bowel sounds. An electrocardiogram showed sinus tachycardia and changes indicative of extensive anterior myocardial ischemia. A roentgenogram of the chest was normal. A plain film of the abdomen revealed radiopaque material in the region of the stomach and pancreas. The patient went into profound shock shortly after admission; his condition deteriorated rapidly, and he died with a generalized convulsion within three hours. A coroner's autopsy disclosed arsenic poisoning. Upon questioning, the wife of the patient admitted that for the past three weeks she had been spreading rat poison on the sandwiches the patient took to work each day.

The correct diagnosis in this case was not considered prior to death. The authors believe that the possibility of arsenic or other heavy metal poisoning should be kept in mind in any acute abdominal syndrome, the cause of which is not readily apparent. The presence of radiopaque material in the stomach in such instances furnishes strong evidence of metallic ingestion as the basis for the clinical picture. The electrocardiographic changes in the present case differed from those reported as typical for arsenic poisoning by Josephson (Arch. Indust. Hyg. **4:** 43, 1951). In the authors' opinion it is probable that the electrocardiographic findings depend upon the degree of damage to the coronary vasculature and the myocardium; the ultimate electrocardiographic abnormalities reflect the distribution and degree of the myocardial disturbance.

Six figures, including 1 roentgenogram.

TECHNIC

Rotational Cinefluorography. Fred S. Winter and J. Stauffer Lehman. Am. J. Roentgenol. **82:** 120–124, July 1959. (230 N. Broad St., Philadelphia 2, Penna.)

Rotation of a subject during fluoroscopy is an established practice for the determination of spatial relationships of structures. A tridimensional impression is obtained during axial rotation of a subject when images closer to the observer are seen to move in a direction opposite to far-sided images. In addition, closer images appear to move faster than those located more deeply within the rotating subject, although actually the rate of rotation is the same. The net effect is more pronounced when the images are rather widely displaced from each other. The authors describe a procedure for axial rotation of experimental animals and human subjects during cinefluorography. To effect the axial rotation of animals, a motor-driven plastic cradle has been devised. For human subjects, the dog crib could be replaced by a brat-board type of holder.

Employment of rotational cinefluorography in coronary arteriography with acetylcholine-induced cardiac arrest in the dog is illustrated. The potential clinical applications of the procedure are considered.

Sixteen cinefluorograms; 1 photograph; 1 diagram.

Some Uses for Presacral Oxygen Insufflation. J. G. Sowerbutts. J. Fac. Radiologists **10:** 201–206, October 1959. (London Hospital, London, E. 1, England)

The author reviews the subject of presacral gas in-

sufflation and describes the technic used at the London Hospital. Oxygen is employed as a contrast agent. Carbon dioxide has been tried, but proved unsatisfactory because of its rapid absorption.

As the result of experience gained in a total of 59 patients, the writer feels that this procedure, if carried out with care and attention to detail, is safe and almost painless. It can be expected to outline clearly the kidneys and suprarenal glands in a high proportion of cases. Its chief value is as follows: (1) It confirms suspected enlargement of the kidney shadow as seen in pyelogram films. (2) It is of considerable aid in demonstrating loss of renal parenchyma as a result of chronic pyelonephritis. (3) In cases of hypertension due to pheochromocytoma, it will frequently demonstrate the site and size of the tumor. However, negative findings do not exclude a pheochromocytoma, and, even if one has been shown, the possibility of multiple tumors must be remembered. (4) In cases of Cushing's disease, the investigation may help to differentiate between a tumor and hypertrophy. In the latter condition, both glands should be recognizably enlarged, while in the former, only one gland is enlarged.

Care must be taken not to mistake certain normal structures for an enlarged suprarenal gland. The commonest sources of error in this respect are the fundus of the stomach, tail of the pancreas, anomalous lobe of the liver, anomalous spleen, and fluid in the pyloric antrum and duodenal cap.

Nine roentgenograms; 1 table.

THEODORE E. KEATS, M.D.
University of Missouri

Radiopaque Drains. Marking Soft Rubber Drains for X-Ray Visualization. C. F. Taylor and W. A. Smiley, Jr. J. Kansas M. Soc. **60:** 441–442, October 1959. (State Sanatorium of Tuberculosis, Norton, Kans.)

The number of chest cases in which surgical procedures are performed is increasing, and wide open thoracotomy wounds are not uncommon. Any drain placed in the chest, in the authors' opinion, should be marked so that roentgenograms will reveal it as a foreign body in the chest cavity. It has been found that rubber bands will show fairly well, and at the present time they are being used for marking the Penrose drain. They have the advantage of radiopacity combined with low cost, elasticity, and the ability to be sterilized. A simple arrangement has also been devised for threading the rubber band, or other marking material, through the drain. This procedure has worked out very well and is now being employed for all similar drains used in surgery at the authors' institution.

One roentgenogram; 1 photograph.

RADIOTHERAPY

Carcinoma of the Tonsillar Area: Factors Influencing the Results of Treatment. Norah duV. Tapley, Robert A. Evans, Morton M. Kligerman, and Harold W. Jacox. Am. J. Roentgenol. **82:** 626–633, October 1959. (622 W. 168th St., New York 32, N. Y.)

The authors analyze a group of 81 cases of carcinoma of the tonsillar area in an attempt to discover any factors which might influence the results. Sixty-two patients received x-ray therapy alone, 9 patients had x-ray therapy and additional interstitial radium treatments, and 8 patients were treated by irradiation and radical neck dissection. Two patients had surgery alone, neither of whom survived five years. In the group of 62 patients treated solely by x-rays, 17 five-year survivals were obtained. In the two groups, in which x-rays were supplemented by radium and surgery, respectively, there were 2 five-year survivals each.

The series was analyzed with respect to presenting symptoms, extent of disease, histology, age, etc., but no evidence of any influence on the result of treatment was discovered, with one exception. It was felt that sex did influence the survival rate. The five-year survival rate was 77 per cent for females, as against 21 per cent for males.

Four figures; 4 tables.

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Radiation Therapy in Breast Cancer. Halvor Vermund and Charles Benkendorf. Wisconsin M. J. **58:** 607–616, October 1959. (1300 University Ave., Madison 6, Wisc.)

The authors review previously published articles relative to clinical criteria of operability and results from surgery, radiotherapy, and various therapeutic combinations in breast cancer. A comparison of the five- and ten-year survival figures of Haagensen (Diseases of the Breast. Philadelphia, W. B. Saunders Co., 1956), Engelstad (Am. J. Roentgenol. **60:** 776, 1948. Abst. in Radiology **53:** 774, 1949), and McWhirter (Brit. J. Radiol. **28:** 128, 1955) shows these to be quite similar.

The authors' own experience includes 138 patients with histologically proved breast cancer treated and followed for five years or more. The report is primarily a statistical one, with much subdivision of the case material into various categories of stage of disease, type of treatment, etc. Some of the important statistics include the following: 82 per cent of 38 patients in Group I (no axillary metastases; radical mastectomy and postoperative irradiation) survived for five years; 38 of 100 cases in Group II (operable cancer with axillary node metastases; radical mastectomy plus postoperative roentgen therapy) were alive at five years; 50 per cent of the patients with operable cancer (Groups I and II) survived five years.

Complications of therapy were generally not troublesome. A small proportion of patients had lymphedema of the arm or pulmonary fibrosis, but the incidence is about the same as reported in other series, in the 5 to 8 per cent range.

The technic of postoperative radiotherapy is described briefly. Roughly rectangular fields are mapped out over the anterior chest wall, axillary, and supraclavicular regions, with a smaller rectangular field over the posterior axilla. One course of therapy usually amounted to 1,600 r in air to each of these fields over eight or nine treatment days, with a roentgen beam of about 1 mm. Cu h.v.l. Many of the patients received a second course after three months, and some a third series three months later.

Four photographs; 1 chart; 2 graphs; 14 tables.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Roentgen Therapy of Intrathoracic Neoplasms. Franz Buschke. California Med. **91:** 134–136, September 1959. (University of California Medical Center, San Francisco 22, Calif.)

This paper is a general one in which the author summarizes data from his own studies, as well as from other previously published reports. His observations, criteria of treatment, and general philosophy relative to roentgen therapy are discussed from the standpoint of cancer of the esophagus and cancer of the lung.

An earlier review of statistical results for carcinoma of the esophagus (Buschke: Am. J. Roentgenol. **71:** 9, 1954. Abst. in Radiology **63:** 787, 1954) showed a surprisingly similar, and generally discouraging, status, whether the patient were managed by radiotherapy or surgery. The overall five-year salvage rate was found to be in the range of 3 per cent. Palliation by the two methods also was similar, with approximately one-half of the patients judged benefited. In view of these findings, the author feels that limitations of treatment are more likely biological than technical in nature.

In about one-half of the cases of epidermoid carcinoma of the esophagus, esophageal passage can be reestablished for the duration of the patient's lifetime by suitable radiotherapy. Not infrequently the primary lesion can be controlled, as demonstrated by absence of tumor in this area at autopsy; but the infiltrative disease in adjacent thoracic tissues results in the patient's death. Perforation of the esophagus, previously held an important deterrent to irradiation, has not proved to be a frequent or disastrous complication. In 9 of the author's personal series of 34 patients, perforation developed following a complete course of radiotherapy. It occurred in all cases from one to fifteen months after completion of therapy and seemed likely to be due to the disease itself rather than to the irradiation.

One-half of the patients in the author's group undergoing complete treatment were judged to have had worthwhile palliation. Three were clinically cured for terms of fifteen, thirteen, and two years; three others undergoing autopsy at ten, five, and one year after treatment showed no evidence of local malignant disease. "From the available data it would appear that further technical improvements, either surgical or radiological, are not likely to produce any clinically significant advantage in cancer of the esophagus."

It is pointed out that lesions in the upper portion of the esophagus are more likely to respond to radiotherapy while those lower down seem to do better with surgery. With other factors equal, short, primarily constricting lesions seem more amenable to resection, while proliferating papillary growths are more radioresponsive. The author feels strongly that "less emphasis should be placed on control at any price and more on the chief aims of palliation, i.e., esophageal patency and avoidance of gastrostomy." Such considerations are particularly important in patients of advanced age. It is not felt that so-called palliative resection is justified when exploratory thoracotomy or presurgical work-up indicates that a growth cannot be entirely removed. The grave morbidity associated with such resection is almost always out of proportion to the benefits derived. The esophagus can be reopened in about 50 per cent of cases by irradiation with much less morbidity.

In the author's opinion, radiotherapy for carcinoma of the lung has a definite but quite limited place when directed with appropriate technic against certain specific symptoms. Undifferentiated carcinomas, including oat-cell and small-round-cell types, are generally highly radiosensitive, and local control can be attained with relative ease. Such tumors frequently produce mediastinal embarrassment through rapid enlargement of mediastinal nodes. Symptoms may be effectively palliated in many cases with depth doses of 2,000 to 3,000 r in four weeks. Occasionally intravenous nitrogen mustard therapy is a better choice. Dissemination, however, is rapid. In epidermoid carcinoma or adenocarcinoma in inoperable stages, presenting symptoms are usually due to complications of bronchial obstruction. This can usually be reduced only with high tumor dosage in the range of 5,000 to 6,000 r in five or six weeks. Careful localization of the treatment through small portals to the obstructing tumor will sometimes give worthwhile palliation. Diffuse thoracic pain associated with later invasive stages of these tumors is not likely to be benefited by radiotherapy. Sympathetic nerve block is preferred. Relief of peripheral nerve pain in Pancoast tumor is worth attempting with roentgen therapy.

It is stressed that palliation must be directed toward a specific end and not attempted merely for the sake of "doing something."

JAMES W. BARBER, M.D.
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Metastatic Spread of Corpus Carcinoma, Especially into the Vagina: Means of Prevention. Heinrich Günther Müller. Strahlentherapie **110:** 280-286, October 1959. (In German) (Frauenklinik der Med. Akademie, Düsseldorf, Germany)

The author surveyed 114 cases of corpus carcinoma, seen from 1948 until 1956. In this series, there was metastatic spread to the parametrium in 14 cases (12.2 per cent) and to the vagina in 15 cases (13.1 per cent).

In view of the frequent involvement of adjacent tissues, the following preoperative measures had been instituted in the past eighteen months: (1) preoperative intracavitary radium treatment for devitalizing tumor cells, and (2) irradiation of the upper part of the vagina, cervix, and adjacent parametrium with combined radium applicators, followed by radical hysterectomy in fourteen to sixteen days. When the tumor extends downward into the cervix, a proximal vaginal cuff is resected at the same time. The vagina is tightly closed by clamps for the prevention of metastatic implantation. Postoperative development of vaginal seeding is treated either surgically or by irradiation.

Radical surgical procedures in all cases are hazardous. They are bound to increase the surgical mortality and to keep the survival rate at a low level. This is especially true, since most patients are obese, of advanced age, and/or may suffer from diabetes and hypertension. The value of postoperative radiation therapy is still being disputed and so far lacks statistical proof.

Three tables.

ERNEST KRAFT, M.D.
Northport, N. Y.

Radiation Treatment of Primary Bone Tumors (Osteosarcoma and Reticulosarcoma). F. Baclesse. Radiol. clin. **28:** 276–290, September 1959. (In French) (Fondation Curie, Paris, France)

Among *osteosarcomas* involving the long bones, in young subjects, there are rare varieties that react favorably but exceptionally to roentgen therapy in

high doses. This can be administered in one or two series separated by an interval of several weeks to several months. If the first series is not followed by recalcification and relief of pain, the tumor is resistant and a second series should not be given. Fractionated radiotherapy is biologically wiser than a single massive dose, which is always accompanied by severe tissue changes. None of 5 patients in this group treated solely by irradiation survived as long as five years.

Of 54 patients with *reticulosarcoma* receiving irradiation, 12 had survived five years; in 2 there were late recurrences in the tenth and thirteenth years. Localization in the mandible is especially favorable; 6 of 22 patients with mandibular involvement were living after five to twenty-one years, with no recurrence. Only 1 patient with reticulosarcoma of the long bones survived beyond ten years, and that with adjunctive surgery.

It is absolutely necessary that histologic proof be irrefutable in considering these cases of long survival.

Five roentgenograms; 2 photographs; 6 tables.

CHRISTIAN V. CIMMINO, M.D.
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Hodgkin's Disease in Children. A Clinicopathological Study of 46 Cases. James A. Pitcock, Walter C. Bauer, and Malcolm H. McGavran. Cancer **12:** 1043–1051, September-October 1959. (Washington University School of Medicine, St. Louis, Mo.)

Data on 46 proved cases of Hodgkin's disease in children and adolescents sixteen years of age or younger, seen at the St. Louis Children's Hospital and Barnes Hospital, St. Louis, Mo., from 1914 through 1953, are presented. Forty-four of these had been followed. A peak incidence of the disease occurred around the age of six years. No case was encountered in a child under two years. There were 35 boys and 11 girls in the series. A modification of Peters and Middlemiss' clinical staging (Am. J. Roentgenol. **79:** 114, 1958. Abst. in Radiology **71:** 789, 1958) was employed. In *Stage I*, clinically, only 1 lymph node group is involved, without or with constitutional symptoms. In *Stage II*, two contiguous areas confined above or below the diaphragm are involved. In *Stage III*, disease is generalized with constitutional symptoms.

Irradiation was used as the principal means of treatment in all but 1 of 43 cases for which some therapeutic information was available. Chemotherapy, in the form of nitrogen mustard or triethylene melamine, was employed in only 5 patients after 1954 and then only in the terminal stages of disseminated disease. Surgical procedures were generally limited to lymph node biopsy. In 1 case splenectomy was performed for hemolytic anemia. Definitive primary surgical therapy was carried out in a single patient, a six-year-old boy with localized disease involving the right inguinofemoral lymph nodes.

Analysis of the present series of cases of Hodgkin's disease in children shows that in this age group, contrary to the prevalent view, the disease is not uniformly and rapidly fatal and thus neither warrants a pessimistic approach in the early stages nor justifies therapeutic nihilism. Eight patients (17 per cent) are still alive five to thirty-three years after biopsy.

The most important factor relating to prognosis is the clinical stage of the disease at the time of diagnosis. The five- and ten-year survival rates for patients with Stage I disease are 60 per cent and 35 per cent respectively, whereas all Stage III patients were dead within three years. Survival can also be correlated with the histological type. The more accurate evaluation depends upon both features.

Initial doses of irradiation of less than 1,800 r in Stage I cases failed to eradicate the disease and necessitated retreatment of the lymph node area in all cases. On the basis of the successful outcome in 6 of the 7 Stage I cases receiving in excess of 1,800 r, the authors recommend a therapeutic regimen patterned after that of Peters and Middlemiss and Nice and Stenstrom (Radiology **62:** 641, 1954) as a rational approach to the management of Hodgkin's disease in children. Areas of recrudescence elsewhere, after adequate therapy to the primary site, should be vigorously irradiated; 4 patients (initially Stage I) treated in this fashion were still living at the time of the report, ten to thirty-three years after biopsy.

Nine figures; 4 tables.

The Combination of Oxygen and Optimum Fractionation in Radiation Therapy of Adenocarcinoma. Lucille A. Du Sault, William R. Eyler, and Glen D. Dobben. Am. J. Roentgenol. **82:** 688–692, October 1959. (The Henry Ford Hospital, Detroit, Mich.)

The authors remind us that availability of oxygen increases the effectiveness of radiation therapy. Greater fractionation also improves the results still further. It was previously shown (Radiology **71:** 709, 1958) that if a spontaneous mammary adenocarcinoma in C_3H mice is treated with 2,000 r (air) per week to totals of 6,000 r or 8,000 r, the response is better when treatment is given three times a week than with daily treatments five days a week.

In the present experiment the mice breathed 95 per cent oxygen plus 5 per cent carbon dioxide, the latter being added to stimulate hyperventilation. Some mice were allowed to breath this mixture for half an hour before and during treatment and some animals started breathing the oxygen-carbon dioxide mixture only just before treatment. Tumor response in the two groups failed to show any appreciable difference but more mice died before radiation treatment was finished when allowed to inhale oxygen for half an hour before actual treatment was started. Apparently oxygen has a systemic toxic effect and the period of its administration should be kept as brief as possible. The best results were obtained with the addition of oxygen only during actual treatment time. The advantage of dividing the total dose into fractions given three times a week as compared to daily treatments was, however, still apparent.

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Physical Aspects of Roentgen Therapy Using Wedge Filters. I. Some New Copper Wedges and Their Applications. M. Cohen. Acta radiol. **52:** 65–80, July 1959.

II. Analysis of Wedge Field Dosimetry. M. Cohen. Acta radiol. **52:** 158–176, August 1959.

III. The Effect on Wedge Fields of Variations in kV and Other Factors. M. Cohen and J. E. Burns. Acta radiol. **52:** 470–492, December 1959.

IV. A New Wedge Principle Using Graphite and Tin. M. Cohen. Acta radiol. **53:** 153–165, February 1960. (London Hospital, Whitechapel, London, England)

Wedge fields are ideally suited to the treatment of many lesions near the body surface. Part I of this

series of articles describes four copper wedge filters which have been found to satisfy nearly all the demands of the institution from which this report comes (London Hospital, London, England): 5 × 5 cm., 6 × 8 cm., 6 × 15 cm., and 8 × 10 cm.

Some difficulties peculiar to the plotting of wedge isodose curves are mentioned, and examples are presented of combined wedge and normal field dose distributions. The development of a three-field technic is illustrated, with special reference to the maximum skin dose. From the point of view of dose distribution in the tumor region, however, the two-field arrangements are undoubtedly best.

Over 30 isodose charts for combined fields involving the four wedges have been prepared and the majority of patients can be treated with one or other of these arrangements. (Copies of these charts may be obtained through the Diagrams and Data Scheme of the Hospital Physicists' Association, Mount Vernon Hospital, Northwood, Middlesex, England.)

Six figures; 2 tables.

Those lesions which cannot be fitted to one of the standard arrangements may be treated by an *ad hoc* combination of fields or, better, with use of the dosage charts described in Part II. In dealing with the problem of the non-standard lesion the number of variables is so large that some systematization is necessary if optimum results are to be achieved. The essential features of the dose distribution in a two- or three-field wedge arrangement may be extracted in the form of: mean percentage tumor dose, location of a defined "plateau" relative to a base-line, and "hot-spot factor," *i.e.*, maximum skin dose/mean tumor dose. The following variables are studied: angle between wedges, separation of wedges, width of the normal field, width of the wedge field, and the slope and shape of the wedge isodose lines. The results of the analyses can be presented as "dosage tables" which facilitate a rapid choice of configuration in individual cases.

Fifteen figures; 2 tables.

In Parts I and II it was assumed that the incident radiation was maintained at the specified quality, *i.e.*, 250 kv, clinical filtration 1 mm. Cu + 1 mm. Al, h.v.l. 1.74 mm. Cu, and that no alterations were made in the basic geometry of the wedge applicator. Frequently, however, it is necessary to make some change in these factors.

In Part III, experimental evidence is presented of the effect of changes in incident beam quality on the dose distributions associated with the wedge filters designed for a h.v.l. of 1.74 mm. Cu described in Part I. A harder incident beam results in isodose curves of smaller slope and a lower maximum percentage surface dose, but the central axis percentage depth doses remain virtually unchanged. For practical purposes the dose distribution for a given h.v.l. is independent of the kv-filtration combination.

A method is described whereby isodose curves may be deduced for an incident beam of any desired h.v.l. This involves the specification of central axis percentage depth doses, slopes of isodose curves, and depths of isodose "noses" for a single reference quality, together with correcting coefficients for other qualities. The maximum percentage surface dose may be deduced by a similar method.

The effect of changes in incident beam quality is also discussed with reference to the two- and three-field combinations described earlier. In the case of the 6 × 8-cm. wedge, it is shown that, provided the contribution of the normal field is suitably adjusted, equivalent dose distributions may be obtained with incident beams of any h.v.l. within the range 1.0 to 2.5 mm. Cu. On the other hand, optimum use of the 8 × 10-cm. wedge requires the use of radiation within the upper half of this range.

Preliminary experiments indicate that when the length of a wedge field in the non-wedge direction is decreased by masking with lead strips, slopes of the isodose curves and the maximum percentage surface dose are virtually unchanged, but the central axis percentage depth doses and the surface dose-rate are decreased in essentially the same ratio as when the length of a comparable non-wedge field is similarly decreased.

When a wedge filter is transferred to an applicator of different FSD, satisfactory matching of the isodose charts, for clinical purposes, is obtained when the dimensions of the wedge are changed in the ratio of the widths of the back apertures of the two applicators. For even closer matching, a small correction to the wedge dimensions may be made, based on a consideration of the "point-source," as distinct from the actual dimensions of the back aperture. Similar considerations apply when the wedge filter is transferred from the back aperture to the face of an applicator.

Twelve figures; 4 tables.

Part IV of this paper is concerned with the reduction in the maximum percentage surface dose.

In a copper wedge filter the hardening of the radiation on the thick side of the wedge increases the relative depth doses on that side and therefore opposes the effect of beam attenuation in producing sloping isodose curves. This difficulty can be avoided by the use of material having a low atomic number (*e.g.*, graphite) on the thick side and a material of high atomic number (*e.g.*, tin) on the thin side. The construction and properties of such wedges are described.

The advantages of this method of wedge construction, in addition to a lower maximum skin dose are: The isodose curves retain their slope more effectively at a depth. The surface dose rate is increased by 20 to 25 per cent at a given FSD. Two-material wedges, then, merit serious consideration in deep roentgen therapy, especially where large wedge fields are desired. The principle is of general application where a heterogeneous radiation is to be wedged. Even for roentgen rays generated at 2 to 4 mv, the hardening effect of lead as against aluminum appears to be sufficient to make the method worthwhile.

Disadvantages of two-material wedges are: They must be used without the normal clinical filter. They are more difficult to design and to construct. In part of the field the radiation is soft. However, the radiation which makes the major contribution to the tumor dose is that which passes through the half of the wedge between the central axis and the thin edge. In this half the filtration ranges (in the case of the 5 × 7-cm. wedge) from approximately 0.5 mm. Sn + 0.25 mm. Cu to 0.1 mm. Sn + 0.25 mm. Cu + 40 mm. Cu. The corresponding h.v.l.'s are approximately 2.4 mm. Cu at the "nose" and 1.6 mm. Cu at the central axis. The values for the 5 × 5-cm. copper wedge are 1.7 mm. Cu at the "nose," 2.3 mm. Cu at the central axis, and 3.0 mm. Cu at the thick end. At the thick end of a graphite/tin wedge the graphite filtration hardens the beam to about 1.0 mm. Cu h.v.l.

Seven figures; 1 table.

Measuring Large Radiation Doses: A Nucleonics Report. Nucleonics **17:** 57–76, October 1959.

In this review article the most promising systems of measuring large radiation doses of fast electrons and photons are covered. A bibliography of about 150 references is appended.

(*a*) *Glass Dosimetry* (By Norbert J. Kreidl and Gerald E. Blair): In the range 10^3 to 3×10^5 rads there is a linear relation between dose and change in optical absorption in silver activated phosphate glass. A borosilicate has been developed with linearity of response up to 10^6 rads, good stability, and dose rate independence. Also mentioned is a silver activated phosphate glass developing an ultraviolet-excited orange fluorescence proportional to dose. A cylinder of the glass 1 × 6 mm. measures doses from 1–10,000 rads.

(*b*) *Photographic Methods* (By H. F. Nitka): In the range 10^4–10^8 r a special print-out emulsion is used, in which excess silver ions are deposited on sites whose silver ions were reduced by light absorption. The optical density is measured by a densitometer. The sensitivity of the emulsions is constant above 6 Mev, but below that separate calibrations are required. Response of high-speed print-out emulsions depends somewhat on dose rate in the range 10–10^4 r/min.

Commercial x-ray film responds the same way in the range 10^4–10^8 r. Superposing 3 films increases the density reading precision. The formation of photolytic silver depends on the temperature; for an accuracy better than ± 10 per cent this should be kept within 10° of the calibration temperature.

(*c*) *Luminescence Degradation* (By Frank H. Attix): Among the most promising systems for measuring large radiation doses is luminescence degradation. This employs the decrease in the luminescence of organic luminophors with exposure to high-energy radiation and is applicable in the range 10^6–10^9 rads. Among its advantages are dose-rate independence, simplicity, a good match with plastics in atomic number. Its disadvantages are its nonlinear response and some instability in time. The author used penny-sized wafers of anthracene and *p*-quaterphenyl excited by 3,650 A. Plastics cover a high dose range, but their response depends on the nature of the radiation. A table containing degradation parameters for organic luminophors for various radiation types is included.

(*d*) *Plastics Dosimetry* (By Charles Artandi): The rupture of covalent bonds in polymers on irradiation is followed by color and chemical changes which can be used for dosimetry. Polyvinylchloride shows reproducible coloration proportional to the absorbed dose and can be used in the range 10^6–10^7 rads. The chemical changes which may occur are polymerization degradation and gas evolution. The turbidity of acrylonitrile from its polymerization makes it a visual indicator. The contraction of acrylonitrile vinylacetate, methyl methacrylate or styrene monomers in a dilatometer can also serve for dosimetry. Polystyrene in carbon tetrachloride solution in a flow type viscometer gives a straight line log log plot of a flow time function against a dose rate function. Solid polymethyl methacrylate gives a straight line plot of the reciprocal of viscosity molecular weight versus dose. Polytetrafluoroethylene irradiated under NaOH solution shows evolution of fluorine and the log of dose versus log fluorine per gram of plastic gives a straight line. Polyvinylchloride also has been used with an indicator dye in the plastic film where coloration is measured after irradiation.

(*e*) *Microbial Monitors* (By Velma L. Chandler): Microbial monitors with the same radiation resistance as the organisms that are being sterilized indicate the sterilization of the product. The dry organism is placed on plastic film, exposed, and cultured on agar-gel plaques for detection of any viable survivors. A spore suspension in water on a disk of filter paper is also used, either dry or wet, in a polyethylene envelope. An aluminum step wedge can be employed to produce a dose range of 0.2 to 2.5 × 10^6 rads. A table shows the resistance of various spores to radiation.

(*f*) *Total-Dose Standards* (By Samuel I. Taimuty): Calorimetry and the ferrous sulfate dosimeters are discussed. For dose rates greater than 10^7 ergs/sec accuracies of 1–2 per cent are obtained with calorimeters. One of the adiabatic type is a Pyrex bulb filled with water and a thermocouple; another uses polyethylene loaded with free carbon to increase conductivity, and the National Bureau of Standards has one under development consisting of a graphite sphere inside a graphite shell. When high-intensity beams are used, an insulated calorimeter may be adequate, compensated for heat exchange losses.

The Fricke dosimeter measures spectrophotometrically the ferric ion field from a solution of $FeSO_4$, NaCl, and concentrated H_2SO_4 in distilled water. It is useful in the range 4,000 to 40,000 rads and at rates up to 1.5 × 10^6 r/hr.

(*g*) *Rate Measurements* (By Samuel I. Taimuty): Measurements of electron-beam current and photon radiation intensity are conveniently made with continually indicating devices. A design of a Faraday chamber is given, employing a re-entrant aperture, a low Z absorbing surface to reduce back-scatter, and a permanent magnet to prevent the escape of low energy secondaries. These chambers measure the total charge collected in a given time, when the electron beam is totally absorbed. For pulsed current densities of 150 ma/cm.^{2} and average currents up to 120 μa, secondary emission from a foil can be used to monitor an electron beam.

Absorbed rates of up to 10^7 rads/hr. have been measured in ionization chambers, using a spherical graphite chamber for Co^{60}. Currents are within a few per cent of saturation currents. Semiconductors as direct reading devices have also been used at 400–10^8 r/hr.; *e.g.*, a CdS photovoltaic cell for gammas and a silicon solar cell with an *np* junction for neutrons.

(*h*) *A Comparison of Dosimetry Methods* (By Paul Schall, Jr.): The reproducibility as well as accuracy of a dosimetry system is important. Chemical systems in general are influenced by impurities. Glass dosimeters and those using degradation of substances and darkening of plastics are promising for routine use. Ion chambers are considered most reliable. For doses above 10^7 rads, the choice is limited to nitrous oxide and luminescence degradation, and perhaps some of the newer glasses. Many systems are dose-rate dependent in their ranges and must be suitably calibrated. The cheapest system is probably polymerization. Photon dosimetry may involve expensive readout equipment but generally gives returns in increased convenience and accuracy. Glasses require post-irradiation heat treatment for stability. If dose rates or measuring temperatures are high, temperature effects may become important. The nitrous oxide system is temperature-independent to about 250° C.

(*i*) *Chemical Dosimetry* (By David E. Harmer): A table summarizes the chemical dosimeters, giving the reagent, the maximum dose, the conversion value, and the method of analysis. Among the liquid systems, the most widely used are the Fricke method, copper modified ferrous salt, ceric sulfate, methylene blue dye, chloroform dye, and, in the solid systems, dyed plastic films, and cellophane dye. The Fricke method may be modified for greater sensitivity and dose range. Oxalic acid is mentioned for its large dose range and insensitivity to impurities. Combinations of chlorinated hydrocarbon dosimeters are useful in assessing neutron doses in mixed fields.

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RADIOISOTOPES

Important Non-Biological Contributions to Radioisotopic Diagnosis. The 1959 Arthur Erskine Memorial Lecture. Ralph M. Kniseley. J. Iowa State M. Soc. **49:** 619–624, October 1959. (Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tenn.)

The author discusses the many contributions to radioisotopic diagnosis made by physicists and experts in electricity and electronics—scientists in nonbiological pursuits. A brief history is given of the development of such equipment and apparatus as the cyclotron, the nuclear reactor, the Geiger-Müller tube, scintillation counter, and the photomultiplier. The growing use of complicated pieces of equipment emphasizes the need for continuing close cooperation between medicine and the nonbiological basic sciences so that maximum advantage may continue to be taken of these resources.

One figure; 2 tables.

A Critical Evaluation of External Body Surface Counting in the Determination of Cardiac Output with Radioactive Isotopes. Barbara L. Carter, Sigurd E. Johnsen, R. Kenneth Loeffler, and Martha E. Southard. Am. J. Roentgenol. **82:** 618–625, October 1959. (Temple University Hospital, Philadelphia 40, Penna.)

The estimation of cardiac output can be adequately done by use of the Fick principle of gas exchange or the Hamilton-Stewart method of dye dilution. Both are technically difficult and call for frequent sampling of the blood. Prinzmetal suggested using a gamma-emitting radioactive isotope as an indicator for the Hamilton-Stewart dilution technic, and measuring the concentration of indicator externally by a radiation detector over the precordium (J.A.M.A. **139:** 617, 1949. Abst. in Radiology **54:** 778, 1950). If possible, this would be a simple and valuable procedure, but the authors on the basis of their experimental studies come to the conclusion that this is not an accurate method.

Four figures; 5 tables.

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Measurement of Cardiac Output Using a Radioisotope and a Scintillation Counter. W. A. Seldon, J. B. Hickie, and E. P. George. Brit. Heart J. **21:** 401–406, July 1959. (St. Vincent's Hospital, Sydney, Australia)

This article describes the technic and method of calculation of cardiac output measurement by intravenous injection of 25 millicuries of radioactive iodinated serum albumin. The method is simple and can be performed with ease in any situation. Equipment necessary consists of a scintillating detector, rate-meter, and a chart recorder. Simultaneous output measurements were made by the Fick and the radioisotope version of the Hamilton method in a series of twelve patients. The latter technic involves only external counting over the patient's chest. The standard deviation of the isotope method is found to be close to 10 per cent, a figure frequently quoted for the Fick method. The relative merits of the two methods are discussed

Two figures; 1 table.

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Effect of Thyrotropic Hormone on the Accumulation of Radioactive Iodine in Thyrotoxicosis. A. W. G. Goolden. J. Clin. Endocrinol. **19:** 1252–1257, October 1959. (Hammersmith Hospital, London, W. 12, England)

In this study the thyroidal clearance rate, the 0-8 hour urinary excretion, and the 24-hour thyroidal uptake of I^{131} were determined in 12 cases of thyrotoxicosis, both before and after the injection of TSH (5 U.S.P. units). An increase in the thyroidal clearance rate occurred in all cases after administration of TSH, the average increase being 30 per cent above the initial value. A reduction in the 0–8 hour urinary excretion of I^{131} confirmed the increase in the thyroidal accumulation. Two patients with normal thyroid function were tested in this manner and found to have a threefold increase in the clearance rate after TSH.

No significant change was noted in the 24-hour thyroidal I^{131} uptake, indicating that this test is not suitable for studying the effects of thyrotropic stimulation in subjects with hyperthyroidism.

The author concludes that the thyrotoxic gland responds to TSH qualitatively in the same way as the normal thyroid.

One figure; 1 table.

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Failure of Diethylstilbestrol to Affect Thyroidal Accumulation and Renal Clearance of I^{131}. J. Thomas Dowling, Sidney H. Ingbar, and Norbert Freinkel. J. Clin. Endocrinol. **19:** 1245–1251, October 1959. (Harvard Medical School, Boston, Mass.)

The hormone synthesis of the thyroid gland is increased in pregnancy. Increases in serum-precipitable iodine (SPI) concentration equal to those observed in pregnant women have been induced in nonpregnant subjects by administration of diethylstilbestrol. However, the administration of diethylstilbestrol to nonpregnant euthyroid subjects is without effect on thyroidal accumulation, glandular turnover, or renal excretion of I^{131}.

In a series of 9 euthyroid adults, 30 mg. of diethylstilbestrol was given daily for four to seven weeks. SPI^{131} was determined and estimations of renal clearance of iodine were performed before and during the treatment.

The I^{131} uptake in twenty-four hours ranged from 15.7 to 59.5 per cent, the mean value being 36.4 per cent. Following four weeks of diethylstilbestrol treat-

ment the values ranged from 17.1 to 59.0 per cent with a mean value of 37.1 per cent. The "paired T" test revealed no significant difference in values.

During the estrogen therapy, uptake increased in 4 subjects, decreased in 3, and remained unchanged in 2. The SPI^{131} concentration increased in 3, decreased in 1, and remained unchanged in 2. The renal clearance of I^{131} increased in 5, decreased in 2, and remained unchanged in 2. The volume of distribution of I^{131} increased in 6, and remained unchanged in 3 subjects during administration of diethylstilbestrol.

In the course of these studies, absolute quantities of I^{127} participating in the dynamic processes of thyroidal and renal iodide metabolism were not assessed. The findings fail to account for the difference between the thyroidal responses characteristic of pregnancy and the effects of diethylstilbestrol therapy in nonpregnant subjects. The occurrence of an increase in the volume of distribution of isotopic iodide directs attention to the large increase in extracellular fluid volume characteristic of pregnancy. Thus, during pregnancy, the plasma inorganic iodide level must be reduced, and an increase in the thyroidal clearance of iodide would be required for formation of normal quantities of hormone. The marked increase in renal blood flow and glomerular filtration observed during pregnancy could also contribute to increased thyroidal avidity for iodide by exaggerating the thyroid-renal competition for available circulating iodide.

Two tables. ZOLTAN SZALONTAY, M.D.
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Experience with the in Vitro Erythrocyte Uptake of I^{131}-Labeled *l*-Triiodothyronine in a Routine Clinical Laboratory. Leonard R. Robbins, with the technical assistance of Mary Elizabeth Murphy. J. Clin. Endocrinol. **19:** 1292–1301, October 1959. (The Levy Clinic, Houston, Texas)

The *in vitro* erythrocyte uptake of I^{131} labeled *l*-triiodothyronine (T3) was determined in a small, routine clinical laboratory 424 times in 348 subjects. Duplicate tests were performed, adding 0.1 ml. of diluted I^{131}-labeled T3 to 1.0 ml. aliquots of blood. The tubes were incubated for two hours. The total radioactivity of each tube was measured. The erythrocytes were separated and washed five times with tenfold volumes of isotonic sodium chloride solution. The radioactivity remaining in the erythrocytes was similarly counted.

In euthyroid men, the I^{131} uptake of the erythrocytes was significantly higher than in euthyroid women, the average values being 16.3 for a male and 14.6 for a female. In hyperthyroidism the mean value in women was 18.9 and in men 22.2 per cent. The level of uptake seemed to parallel the degree of toxicity. In hypothyroidism the mean value in males was higher (12.6 per cent) than that of females (11.9 per cent).

The mean T3 uptake of erythrocytes following administration of iodine was significantly higher than in the euthyroid group, but not enough higher to prevent the test from being useful. It was observed that the erythrocyte uptake was low during menstruation, averaging 11.9 per cent. During pregnancy the uptake is also low. It is consistently depressed by the second month of gestation. There was a reduction in uptake with decreased hematocrit readings. A hematocrit of 35 per cent or less should therefore be corrected to normal before uptake determinations are made on the blood.

This test is considered an inexpensive, simple, and rapid means of estimating thyroid function.

Five tables. ZOLTAN SZALONTAY, M.D.
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Radioiodine in the Treatment of Hyperthyroidism. A Seven-Year Evaluation. Sidney Rubenfeld, Martin Lowenthal, Anthony Kohn, Nathan Mitchell, and S. Steven Brodie. Arch. Int. Med. **104:** 532–538, October 1959. (755 Park Ave., New York 21, N. Y.)

The authors report their experience with 294 consecutive cases of hyperthyroidism treated with radioactive iodine and followed over a period of seven years. The oldest patient was seventy-eight and the youngest was sixteen. It was not felt that I^{131} should be withheld from the 86 patients under forty years of age because of the possibility of producing thyroid cancer, leukemia, and gene mutations; these complications did not materialize in the present series. It is held that in any individual, one must weigh the risk inherent in the administration of ionizing radiation against the risk of any other modality of treatment.

In 96 patients the thyroid was not palpably enlarged. Seventy-one glands were nodular and 193 diffuse. Thyroidectomy had been performed in the remaining 30 patients. One hundred and seventy-six patients had had no previous treatment, and 72 had received antithyroid medication for periods up to two years.

An empirical dosage schedule in rep was assigned to arbitrary age groups and ranged from 3,000 to 15,000 rep. Variation in dosage within each age group depended on the degree of thyrotoxicosis and character of the gland. The dosage in rep was translated to millicuries by means of the Marinelli-Quimby-Hine formula (Am. J. Roentgenol. **59:** 260, 1948). With this method, therapeutic doses averaged less than in most comparable series. The lower incidence of hypothyroidism encountered in the present series may be attributable to the smaller doses. At the same time, the remission rate equals that produced by much larger doses.

The diffuse toxic thyroid gland was made to regress with relatively small doses of I^{131}. Actually, 117 patients of 184 (63 per cent) with diffuse goiters were controlled with 6 mc or less, whereas only 29 of 69 (42 per cent) of the patients with nodular glands responded favorably to a similar dose. Approximately two-thirds of the total number of patients (194 of 294) were controlled by a single dose of radioactive iodine. Generally, a patient stood a two-to-one chance of responding to any individual dose. Eighty-eight per cent of all the patients, both with diffuse and nodular thyroids, were controlled by one or two doses of I^{131}. In 63 per cent of all the patients a positive response was evident by the end of the third month.

The toxic thyroid, controlled for one year or more, rarely exhibited a recrudescence. Patients in this series maintained remissions up to a period of seven years.

Twenty-four patients (8 per cent) became hypothyroid, 18 within the first year. If hypothyroidism persisted for more than three months, reversion to the euthyroid state was not observed. The over-all cure rate was 93 per cent; this figure includes the 8 per cent of cases rendered hypothyroid.

There were 81 cases of exophthalmos, ranging in severity from 1 to 4+; 38 cases displayed improvement, 41 remained unchanged, and 2 were moderately aggravated by the administration of I^{131}.

A group of 80 patients who were given Lugol's solution, beginning twenty-four hours after the therapeutic I^{131}, showed that the administration of this stable iodine does not influence the effective half-life, and similarly did not alter the eventual clinical result.

Twelve tables.

Localization of Radioiodinated Rat Fibrinogen in Transplanted Rat Tumors. Eugene D. Day, Jakob A. Planinsek, and David Pressman. J. Nat. Cancer Inst. **23:** 799–821, October 1959. (Rowell Park Memorial Institute, Buffalo, N. Y.)

Radioiodinated rat fibrinogen localized in three different transplantable rat tumors during the initial inflammatory reaction of the host to the implant and during the rapid growth stage of the tumor. Extent of localization during inflammation paralleled the amount of tissue inflamed; extent of localization during subsequent tumor growth paralleled the rate of tumor growth. In the Murphy-Sturm lymphosarcoma at its most vigorous state (10 grams, eight days after implantation), 40 per cent of the intravenously injected fibrinogen localized in the tumor in six hours as the tumor grew nearly 2 more grams. Disappearance of labeled fibrinogen from the tumors was slower than from the blood, but when antifibrin antibodies were present, the disappearance of labeled fibrinogen from both was markedly hastened without a parallel disappearance of antibody.

Seven figures; 5 tables. AUTHORS' SUMMARY

Vascular-Extravascular Exchange of I^{131} Plasma Proteins in the Rat. William C. Dewey. Am. J. Physiol. **197:** 423–431, August 1959. (Department of Radiation Biology, University of Rochester, Rochester, N. Y.)

Rates at which plasma proteins penetrate from the vascular system into extravascular spaces in tissues was measured with I^{131}-labeled rabbit gamma globulin, rat gamma and beta globulins, and rat albumin. After vascular mixing was complete, as measured with Cr^{51}-labeled erythrocytes, initial rates of increase in the ratio of tissue radioactivity to plasma radioactivity were used to calculate vascular-extravascular transfer rates; these are reported as grams blood plasma equivalents which penetrate the vascular-extravascular barrier in 1 gm. tissue each hour. Transfer rates (*i.e.*, the number of gram plasma equivalents which transfer each hour into the extravascular space of 1 gm. tissue) ranged from 0.06–0.76 for visceral organs to 0.0005–0.005 for tissues such as muscle, fat, and skin; the transfer rates were roughly proportional to the vascularity of the tissues. Ratios of tissue to plasma radioactivity reached at equilibrium were employed to calculate the amounts of plasma proteins present extravascularly. These protein masses ranged from 0.02 gm. plasma equivalents per gm. tissue for muscle to 0.13 for skin. Significant differences between the various plasma proteins were found only in the liver, spleen, and stomach.

Seven figures; 2 tables. AUTHOR'S ABSTRACT

Localization and Retention of Triolein I^{131} in Various Tissues of the Atherosclerotic Rabbit. Leland Felton, Meyer Friedman, Sanford O. Byers, and Paxton Cady. With the technical assistance of Veronica Mena. Am. J. Physiol. **197:** 351–354, August 1959. (Mount Zion Hospital & Medical Center, San Francisco, Calif.)

The rate of disappearance of intravenously injected triolein I^{131} from the blood stream and its concentration in various tissues were studied both in the normal and in the atherosclerotic rabbit. No difference in the rate of disappearance of the I^{131} from the blood was observed between the two groups of animals. The atherosclerotic aorta was found to take up approximately twice as much I^{131} as the normal aorta when the tissues were assayed ten minutes after injection. At twenty-four hours after injection, however, no essential difference was detected. All other tissues examined (fat, adrenal, spleen, and liver) took up and retained more I^{131} than either the normal or the diseased aorta. The results suggest that the atherosclerotic aorta of the rabbit, while taking up initially more I^{131} than the normal aorta, appears to metabolize or otherwise rid itself of such I^{131} as rapidly as the latter in a period of twenty-four hours.

The In-Vitro Uptake of ^{32}P by Red Blood-Cells in Thyroid Disease. Helen E. A. Farran, P. Milutinovic, and A. Stuart Mason. Lancet **2:** 537–539, Oct. 10, 1959. (New End Hospital, London, N. W. 3, England)

A relatively simple technic is described for measuring *in vitro* the rate of uptake of radioactive phosphorus (P^{32}) by the red blood cells, and the results in 100 patients are discussed. The technic is similar to that devised by Prankerd and Altman (Biochem. J. **58:** 622, 1954). It consists essentially in incubation of P^{32} in blood drawn for the purpose and calculation of the rate at which the isotope enters the blood cells from serial measurements of the amount remaining in the plasma at different times, and from the hematocrit.

It was found that P^{32} was taken up rapidly in thyrotoxic patients, and slowly in those with myxedema. The procedure can be employed during or immediately after stopping treatment with antithyroid drugs or with thyroid preparations, and it has the advantage that the patient does not receive any radiation. Serial measurements of P^{32} uptake by the red cells provide a reliable guide to the patient's thyroid status during treatment for thyrotoxicosis or myxedema. The test is of particular value under those conditions which invalidate I^{131} technics. Clinical study of patients in whom the results were anomalous showed that there are conditions in which the test is not specific for thyroid function. Abnormally high values were observed in patients being treated with large doses of cortisone or its analogues. In certain cardiac disorders the results were in the lower range of normal and in the hypothyroid range.

Radioactive Phosphorus (P^{32}) Studies in Transplanted Carcinoma. I. Incorporation of P^{32} Measured by Surface Activity in Walker Carcinoma and Normal Tissues of Albino Rats. Donald B. Shahon. Cancer **12:** 962–965, September-October 1959. (University Hospitals, Minneapolis 14, Minn.)

An investigation was undertaken to determine if an optimum time interval after P^{32} injection existed that would provide the greatest differential uptake between malignant and benign or normal tissues and thus minimize the incidence of false positive determinations. Twenty-nine rats, including both males and females, were divided into three groups. In the 10 rats of Group I, a Walker carcinoma was transplanted into the posterior surface of the right ear. In the 9 rats of Group II, acute inflammatory lesions were produced by the subcutaneous injection of 0.2 c.c. of xylol into the back of the right ear twenty-four hours prior to P^{32}

injection. The 10 animals of Group III had tumors transplanted in the right ear and an inflammatory lesion created, as above, in the left. In the "tumor only" and "inflammation only" groups, the opposite ear served as the control. P^{32} as phosphoric acid was injected intraperitoneally, and daily surface activity measurements were performed at the same time of day, thus minimizing any diurnal and nocturnal variations.

The surface activity of the Walker carcinoma after P^{32} administration was found to be significantly greater than that over inflammatory areas and corresponding normal areas. This was a consistent observation over a six-day period. Whether this increase is due to the increased thickness of the tumor area (thus increasing the volume of cells being counted) or is the result of the tumor cell *per se* incorporating a greater amount of radiophosphorus than the individual normal cell is not known.

Four figures; 1 table.

Radioactive Phosphorus (P^{32}) Studies in Transplanted Carcinoma. II. Total P^{32} Turnover in Transplanted Mammary Carcinoma, Inflammatory Granuloma, and Normal Stomach Tissue of ZBC Mice. Donald B. Shahon. Cancer **12:** 966–969, September–October 1959. (University Hospitals, Minneapolis 14, Minn.)

Various investigators have reported that malignant tissues take up a greater percentage of administered radioactive phosphorus than do normal tissues. This property of P^{32} has been attributed to the increased metabolic activity and turnover of phosphorus in cancerous tissue. To determine if this persisted over a prolonged period after injection of P^{32}, a comparative study was made of phosphorus turnover in transplanted mammary adenocarcinoma C3HBA in ZBC mice as compared both to a benign lesion, such as an inflammatory granuloma, and to the normal mouse stomach in the same animals.

Eighty-eight C3H mice (males and females) were studied. In one group of 56 animals, mammary adenocarcinoma transplantation was accomplished successfully. In the remaining 32 mice, injections were made into the right thigh of a suspension of tumor shown to be necrotic by absence of viable tumor cells microscopically. In this second group, inflammatory granulomatous lesions developed, with no histologic verification of malignant tissue. Some animals in the tumor group and some in the inflammatory granuloma group were killed four hours after injection; others were killed 24 hours, 48 hours, 96 hours, or 192 hours after the intraperitoneal administration of 2.0 μc of P^{32} per gram of body weight, as sodium phosphate. A significantly greater phosphorus turnover was found in the transplanted mammary adenocarcinoma, and this persisted up to 192 hours after injection. This increase in the specific activity of malignant tissues may be either a result of an increased metabolic activity of the individual tumor cell as compared to the individual normal cell or a result of the greater number of cells per cubic centimeter found in tumor tissue as compared to benign lesions or normal body tissue.

One figure; 2 tables.

The Use of Radioactive Phosphorus in the Management of Advanced Carcinoma of the Prostate. Vincent Vermooten, J. R. Maxfield, Jr., and J. G. S. Maxfield. West J. Surg. **67:** 245–249, September–October 1959. (Texas Radiation and Tumor Institute, Dallas, Texas)

Twenty-seven cases of advanced metastatic carcinoma of the prostate were treated by radioactive phosphorus (P^{32}) during the past ten years. All patients had received previous hormone therapy, orchiectomy, and radiotherapy without control of the disease. The authors' regimen included daily intramuscular administration of 100 mg. of testosterone for three days before beginning treatment with P^{32} and continuing during treatment and for five days thereafter. The P^{32} is administered intravenously in divided doses over a period of a week to ten days until 6 to 12 mc have been given. In the typical patient showing a favorable response, relief of pain occurred promptly and there seemed to be some prolongation of life. [In some cases reported here the issue is clouded by concurrent use of local telecobalt therapy.—J. W. B.]

Of the 27 patients in this series, 13 died with carcinoma; 14 were still alive at the time of this report and had been kept free of pain for periods varying from three months to two years. In some cases there was a reversal of osteolytic and osteoblastic processes in bones, with occasional high-grade resolution. No serious bone marrow depression was produced in any of the cases.

Previous studies by others have shown that concentration of radioactive phosphorus is much greater in metastatic lesions in the bones than in the primary prostatic adenocarcinoma. The authors present some autoradiographs to demonstrate this phenomenon. The use of testosterone is said to produce a "reactivation of the carcinoma," thus favoring a higher P^{32} uptake.

Six representative case summaries are presented.

Seven roentgenograms; 3 autoradiographs.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

On the Use of Bi-Axial Rotation Therapy with Cobalt^{60}: Physical Basis and Application in the Treatment of Carcinoma of the Cervix. Roger Mathieu. J. Canad. A. Radiologists **10:** 47–50, September 1959, (Notre Dame Hospital, Montreal, P.Q., Canada)

A study was undertaken to determine the possibilities of rotation technics with Co^{60} for carcinoma of the cervix. Since the physical value of any radiation can best be assessed by studying the distribution of radiation within an appropriate phantom, the author constructed a phantom of Presdwood and obtained isodose curves on the basis of which the rotation and irradiation factors were chosen for the individual case.

A contour of the patient is obtained with a special device and from this the radii are measured for each side and the tumor-air ratio for each radius is taken from Johns' tables (Johns, Morrison, and Whitmore: Am. J. Roentgenol. **75:** 1105, 1956. Abst. in Radiology **68:** 631, 1957). From these is calculated the fraction of the tumor exposure dose at both axes due to direct radiation. To this is added the contribution at the right axis due to rotation around the left axis and *vice versa*. The contribution at the axes, at the cervix, or at any other point, is calculated using the Braestrup method of calculation (Braestrup and Mooney: Radiology **64:** 17, 1955).

The number and percentage of patients treated by the bi-axial rotation technic as compared to the total number of patients treated by radiation therapy during the years 1956–1958 are presented in table form. The bi-axial technic was used in 46 cases with tissue doses in the order of 6,000 roentgens given over a period of six to

eight weeks. A detailed clinical study of these cases will be presented in a later paper.

Two figures; 2 tables.

MAJ. WILLIAM H. ELLSWOOD, M.C.
Lackland AFB, Texas

Kilocurie Cobalt 60 Therapy at the Radiumhemmet: Equipment, Technique and Dose Measurements. S. Hultberg, O. Dahl, R. Thoraeus, K. J. Vikterlöf, and R. Walstam. Acta radiol. Suppl. 179, 1959. (Radiumhemmet, Stockholm, Sweden)

The authors describe a cobalt teletherapy unit built according to their own design. The calibration of the output of the unit, determinations of h.v.l.'s in lead, copper, and water, and the protection measurements are given. The technic of treatment planning and setting up of the patient for therapy are presented.

About half the book consists of a collection of dose distributions shown by isodose lines for various combinations of stationary and moving-beam therapy. These are given for circular and elliptical cylinders of several different diameters, so that almost any clinical situation can be approximated.

Sixty-three figures; 135 charts; 13 tables.

LUCILLE A. DUSAULT
The Henry Ford Hospital

Radiotherapy of Carcinoma of the Larynx with Radioactive Cobalt, Strontium, and Cesium. Juraj Körbler, Ivo Padovan, and Pavao Frank. Radiol. clin. **28:** 174–179, May 1959. (In German) (Krankenhaus "Dr. Mladen Stojanovic," Zagreb, Jugoslavia)

The authors report a method of local irradiation of cancer of the larynx with radioactive cobalt, strontium, and cesium. Radioactive cobalt is used in gold-plated pearls with a diameter of 6.0 mm. and an activity of 8.6 to 8.9 millicuries. The pearls are threaded through a central hole on a wire and are then placed with the help of a laryngoscope in the larynx. The wire is fastened through the nose and occasionally through a tracheotomy opening on the neck. On an average, twenty-four hours is required to deliver 7,000 to 8,000 r. The immediate result has so far been satisfactory. This method was also employed for the treatment of papillomatosis of the larynx in children, with a dosage of 3,000 r or less, but recurrences are frequent.

Cesium was used in a similar manner; cesium tubes of 25 millicuries, 15.0 mm. in length and 2.0 mm. diameter, were placed in rubber tubes and introduced in the larynx. The twenty-four hour dosage is about 5,000 r; the results were similar to those with cobalt.

For very superficial forms of carcinoma of the larynx, strontium was used through a laryngofissure. The strontium dosage varied between 4,000 and 9,000 rep. Breathing difficulties, edema, or perichondritis did not occur. The authors believe that their method of irradiation of carcinoma of the larynx is easier for the patient and so far has given good immediate results.

Two roentgenograms; 2 photographs.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

The Creation of Deep Cerebral Lesions by Small Beta-Ray Sources Implanted Under Guidance of Fluoroscopic Image Intensifiers (as Used in the Treatment of Parkinson's Disease). Sean Mullan, Robert D. Moseley, Jr., and Paul V. Harper, Jr. Am. J. Roentgenol. **82:** 613–617, October 1959. (University of Chicago Clinics, Chicago 37, Ill.)

The authors describe their treatment of Parkinson's disease in 8 cases by implantation of palladium 109 in the basal ganglial area, for destruction of small areas of the globus pallidus and thalamus by the emission of beta rays. Small lesions measuring 5 to 6 mm. in diameter are created at the sites of implantation; these areas develop rapidly and stop enlarging in ninety minutes. They are visible as early as forty-five minutes after implantation. Palladium 109 has a half-life of 13.5 hours, which accounts for its brief activity.

The palladium is in the form of wires 3 mm. long, weighing 2.8 mg., with an activity of 20 millicuries. Twenty-five to thirty cubic centimeters of air is introduced into the lumbar or cisternal subarachnoid space, without removal of fluid, and the anterior and posterior commissures, the floor of the third venticle, and often the mammillary bodies are identified. With these as reference points, the implantation site is chosen. A burr hole is made in a convenient location, and several days later the isotope is introduced through a long spinal needle, under the guidance of fluoroscopic image amplifiers, with a wire grid placed in front of the screen to measure distances. This procedure gives a skin dose to the patient approximately equivalent to that involved in a gastroduodenal examination.

The only drawback to this method is the short life of the palladium 109, which means that the hospital must be near the source of the isotope. Possible substitutes are Sr^{90} with a half-life of twenty-eight years and Ag^{111} with a half-life of seven and a half days.

The authors do not describe their results in detail but state that "satisfactory alleviation of the tremor and rigidity of the disease has been attained by this method."

Eight figures, including 2 roentgenograms.

PAUL MASSIK, M.D.
Quincy, Mass.

Intestinal Absorption of Liver-Bound Radiovitamin B_{12} in Patients with Pernicious Anaemia and in Controls. P. G. Reizenstein and W. Nyberg. Lancet **2:** 248–252, Sept. 5, 1959. (P.G.R., Karolinska Sjukhuset, Stockholm, Sweden)

The intestinal absorption of radioactivity after the oral administration of liver containing Co^{60}-labeled vitamin B_{12} was compared with the absorption of crystalline radiovitamin solutions in 9 healthy volunteers, 2 patients with irrelevant diseases (hypoplastic anemia and mediastinal tuberculosis), and 10 patients with defective vitamin-B_{12} absorption. Both controls and pernicious-anemia patients apparently absorbed more of the liver-B_{12}. The hematological response after eating liver was greatest when most radioactivity was absorbed. After ingestion of liver, some 10 per cent of the radioactivity was calculated to be present in the plasma. These findings are critically reviewed and their possible therapeutic implications are discussed.

Two graphs; 5 tables.

Implantation of the Pituitary with Yttrium^{90} in a Case of Cushing's Syndrome. G. M. Molinatti, F. Camanni, and M. Tedeschi. J. Clin. Endocrinol. **19:** 1144–1150, September 1959. (University of Turin, Turin, Italy)

This is a full case report of a 27-year-old white male with the clinical picture of Cushing's syndrome. He was treated by implantation of one pellet of yttrium 90

(5.4 mc) into the pituitary. Three months after the implantation the clinical symptoms had disappeared, and after eight months the patient was in perfect health and working normally. That it is possible by means of yttrium-90 implantation to correct the hypersecretion of one hormone of the pituitary without inducing total hypopituitarism has been previously reported by the authors in 2 cases of malignant exophthalmos (J. Clin. Endocrinol. **19:** 583, 1959. Abst. in Radiology **74:** 524, 1960). They believe that implantation of pituitary with yttrium 90 causes a functional inhibition of only those cells which are pathologically hyperactive, without injury to the normal tissue. This could be explained on the basis of the fundamental rule of radiobiology that hyperactive cells are much more sensitive to irradiation than are normal cells.

Two roentgenograms; 4 photographs; 3 graphs; 1 table. WYNTON H. CARROLL, M.D.
Shreveport, La.

Oxidation to $C^{14}O_2$ and Conversion to Fatty Acids of C^{14}-Glucose in Livers of Normal, Fasted and X-Irradiated Rats. John G. Coniglio, Deborah L. Cate, Bryant Benson, and Granville W. Hudson. Am. J. Physiol. 197: 674–676, September 1959. (Vanderbilt University School of Medicine, Nashville, Tenn.)

The studies described here were undertaken in an effort to determine whether any differences existed between the irradiated fasted rat and its fasted control in the relative contribution of the shunt pathway of glycolysis to the total glycolytic breakdown of glucose. They consisted of an investigation of oxidation to $C^{14}O_2$ and the conversion to fatty acids of glucose-1-C^{14} and glucose-6-C^{14} in slices and homogenates of livers of x-irradiated fasted and and nonirradiated fed and fasted control rats.

The oxidation of glucose-1-C^{14} and of glucose-6-C^{14} to $C^{14}O_2$ was found to be greater in slices and homogenates of livers of rats given 1,000 r total-body x-irradiation and fasted twenty-four to forty-eight hours than in their nonirradiated fasted controls. The ratio: $C^{14}O_2$ from glucose-6-C^{14} $C^{14}O_2$ from glucose-1-C^{14} was not altered in homogenates either by fasting or by x-irradiation. In liver slices, the ratio was increased by fasting, *per se*, but was not affected by x-irradiation. In rats weighing 350–400 gm., hepatic conversion of glucose-1-C^{14} and of glucose-6-C^{14} to fatty acids was greater in the irradiated fasted animals than in nonirradiated fasted controls although the ratio C^{14}-fatty acids from glucose-6-C^{14}/C^{14}-fatty acids from glucose-1-C^{14} was not affected by irradiation. In rats weighing 160–200 gm., no difference in lipogenesis from either glucose-1-C^{14} or glucose-6-C^{14} was apparent between irradiated and control rats.

Three tables.

Deposition and Retention of Fluoride and Radiocalcium in the Growing Rat. R. C. Likins, R. O. Scow, I. Zipkin, and A. C. Steere. Am. J. Physiol. **197:** 75–80, July 1959. (National Institute of Dental Research, Bethesda, Md.)

Radiocalcium and fluoride were administered daily for thirty days to young rats. At thirty and sixty days, the tibia, femur, mandible, teeth, and remaining skeleton were analyzed for Ca^{45} and F. The tibia was divided into several segments including the proximal epiphysis, the original diaphyseal segment, and those portions added (by growth) from zero to thirty days and from thirty to sixty days. Fluoride had no effect on the Ca^{45} or ash of bone but reduced Ca^{45} uptake by molar enamel. Ratios of F to Ca^{45} were dissimilar in the various tibial segments. Between thirty and sixty days essentially no Ca^{45} or F was lost from the skeleton, tibia, or tibial segments, excepting the 0-30-day proximal diaphyseal increment. Seventy per cent of the Ca^{45} and 40 per cent of the F lost from this segment were found in the adjacent segment formed during the second 30-day period. These results suggest that much of the Ca^{45} and F released during remodeling of the ends of the growing bone did not enter the general circulation, but was deposited in the immediate vicinity.

Three roentgenograms; 1 drawing; 3 tables.
AUTHORS' ABSTRACT

Transfer of Radioactive Iron Via the Placenta and Accessory Fetal Membranes in the Rabbit. J. Davies, E. B. Brown, Jr., D. Stewart, C. W. Terry, and J. Sisson. Am. J. Physiol. **197:** 87–92, July 1959. (Washington University Medical School, St. Louis, Mo.)

The distribution of radioactivity in the fetus and placental structures was studied at different stages of gestation in the rabbit following the intravenous injection of radioactive iron as Fe^{59} sulfate. The following general results were obtained: (1) A steady increase in the uptake of radioiron by the fetus and fetal placenta took place with advancing gestation. The rate of uptake showed a sharp increase at about the twentieth day. (2) The rate of iron transport across the placenta increased during gestation, especially in the last third of pregnancy. (3) Radioiron was concentrated in the yolk sac in the early stages and in the fetal liver in the later stage of gestation. No change in the pattern of accumulation of radioiron by the fetus took place when the vessels of the yolk sac were ligated before injection. These results suggest that the yolk sac has no role in iron transport and that early in gestation it may carry on some of the functions of the fetal liver with respect to iron. (4) Alternative sites of transport for iron were investigated by the injection of radioiron into the uterine cavity. The results indicate that if iron gains access to the uterine cavity, *e.g.*, *via* the uterine mucosa or *via* the chorion and periplacental decidua, it is rapidly absorbed by the yolk sac and enters the fetus. However, such a pathway for iron transfer to the fetus does not seem to be important physiologically.

Four figures; 4 tables. AUTHORS' ABSTRACT

Recent Studies on Carbohydrate Metabolism. E. B. Chain. Brit. M. J. **2:** 709–719, Oct. 17, 1959. (Istituto Superiore di Sanità, Rome, Italy)

The author describes the new technic of automatic quantitative radiochromatography. This constitutes a powerful tool for studies on intermediate metabolism and opens up new avenues not readily accessible by other methods. It is of particular importance for studies connected with the elucidation of the mode of action of drugs and hormones, but should also be of interest to the clinician as a possible tool to obtain, from bioptic samples of tissues, a picture of their functional biochemical state which may eventually prove of considerable value for diagnostic purposes and complement the histologic microscopic methods at present employed.

Insulin was chosen for investigation because it has been shown to stimulate glucose uptake and glycogen synthesis in the isolated rat diaphragm. It was thought that so much progress in the understanding of the reac-

tions of intermediate carbohydrate metabolism had been made and so many new powerful analytical tools for its study had become available that it should be possible either to fit insulin into the existing reaction schemes or else bring to light some new important reactions which had hitherto escaped attention. Two theories have been advanced for the mode of action of insulin—the permeability theory, according to which insulin acts by increasing the permeability of the cell to glucose, and the hexokinase theory, according to which there is formation of glucose-6-phosphate from adenosine triphosphate. Neither of these theories, the author believes, can be reconciled with the experimental facts.

Special applications of automatic quantitative radiochromotography with C^{14}-, P^{32}-, or N^{15}-metabolites are discussed. Studies were made on the *in vitro* effect of insulin on glycogen synthesis in the rat diaphragm; action of insulin on glucose metabolism in the isolated diaphragm muscle of the rat; action on insulin on glucose metabolism in the isolated brown adipose tissue of the rat; the fate of glucose and fructose in brain tissue; the fate of glucose in the rat pituitary.

Sixteen figures; 16 tables.

The Physical Aspects of a Cesium Teletherapy Source. Charles S. Simons, Isadore Lampe, and Howard B. Latourette. Am. J. Roentgenol. **82:** 587–596, October 1959. (Alice Crocker Lloyd Radiation Therapy Center, Ann Arbor, Mich.)

The authors have set up a cesium barium 137 AECL Model B. Theratron. It was necessary to modify the usual criteria for teletherapy, and the following factors resulted: (1) a 2,000 curie source; (2) a large source diameter ($1^1/_4$-inches or 3.184 cm.); (3) 50-cm. source-skin distance. This last was necessitated by the low output of the cesium source, 8 r per minute at 1 meter. Secondary diaphragms had to be used with the cones to limit the fields satisfactorily.

A comparison of cesium at 50 cm. S.S.D. and cobalt at 73.3 cm. S.S.D. shows similar isodose curves with no greater penumbra for cesium, but a greater depth dose for cobalt, particularly with smaller fields. With a 10 × 10 cm. field, cobalt gives a 25 per cent greater depth dose.

Thirteen figures; 5 tables.

PAUL MASSIK, M.D.
Quincy, Mass.

RADIATION EFFECTS

A Note on Radiation Telangiectases. William B. Bean. Arch. Int. Med. **104:** 622–624, October 1959. (University Hospitals, Iowa City, Iowa)

The author reports a case in which irradiation over the abdomen produced telangiectasis about the navel and in a twenty-six-year old scar. The patient was first seen by the author in September 1949, when she was fifty-one years of age. In November 1946, a mass had been palpable in the abdomen. Surgical exploration disclosed a retroperitoneal tumor, which proved to be a giant follicular lymphoma. X-irradiation was administered over the abdomen postoperatively: 960 r in January and 960 r in April 1947, and 1,800 r in a course completed in September 1948. The patient's condition improved after the first and second courses, but there was little improvement following the third. Roentgen examination revealed a mass outside of the stomach but adherent to the greater curvature; the stomach emptied slowly.

The patient appeared chronically ill. The skin in the irradiated areas was pigmented. A lymph node 3 cm. in diameter was palpable below the left inguinal ligament. The abdominal wall felt somewhat thickened beneath a very thin layer of fat. The right lobe of the liver was slightly enlarged and a little tender. In the left upper quadrant was a tender mass which descended on inspiration. There was a well healed midline scar from an operation for "female trouble," performed when the patient was twenty-two (1920), and a scar in the left upper quadrant from the operation of 1946. The patient was given 5.2 mg. of mechlorethamine hydrochloride (nitrogen mustard) on four consecutive evenings and was discharged improved. In May 1950, she received 5 mg. of triethylene melamine on two consecutive days.

In September 1952, the patient was again seen and stated that on two occasions she had suffered from an evil-smelling discharge from the umbilicus. She was given four more injections of nitrogen mustard. For the first time irradiation telangiectases were seen over the abdomen. In November 1958 the patient was in surprisingly good condition, but the abdominal mass was still palpable. Telangiectases were present only in that part of the scar of the 1920 operation which had been heavily irradiated. There was no increase in telangiectasis in the scar of the more recent operation. Telangiectases were scattered over the left side of the abdomen from a line 3 cm. above the umbilicus to the flank, and a few more as far as 3 cm. to the right of the umbilicus. The margins between affected and normal skin were sharply defined.

The author believes that systematic study of such telangiectases might shed light on the whole problem of vascular lesions and the patterns of their cutaneous localization. The role of the circulation in susceptibility to cancer might also be clarified.

One photograph.

Leukemia and Exposure to X-Ray: A Report of 6 Cases. William C. Moloney. Blood **14:** 1137–1142, October 1959. (Boston City Hospital, Boston, Mass.)

The leukemogenic role of ionizing radiations has been demonstrated experimentally in animals but proof in man has been largely circumstantial or statistically derived. The etiologic role of x-rays or radioactive substances in the individual case is difficult to evaluate. It seems apparent, however, that a considerable amount of irradiation is ordinarily required to produce leukemia in the adult man.

The author makes brief report of 6 cases observed by him in which he believes ionizing radiations *may* have been important in the production of subsequent leukemia. The two best documented cases concern white males treated by roentgen therapy for malignant testicular tumors, receiving therapeutic doses of ionizing radiations to the paravertebral regions. Latent periods of five and thirteen years were observed before the onset of acute myeloblastic leukemia. The third case, also myeloblastic, occurred in a sixty-six-year-old female with a complicated medical history including multiple

diagnostic examinations of the abdomen and spine plus a course of roentgen therapy for cervical bursitis and arthritis. The latent period was indeterminate. The fourth patient was also a sixty-six-year-old female, treated twenty years previously for bleeding uterine fibroids, with a total dose of 1,600 r to the pelvis and lower abdomen. Cause-and-effect relationships appear rather questionable in this case, one of acute myelogenous leukemia. The fifth patient, a fifty-six-year old woman, received roentgen therapy to the chest wall following radical mastectomy for cancer of the breast. After a latent period of sixteen months, acute myelogenous leukemia developed. This case also appears questionable for cause-and-effect relationships. The final case was that in a thirty-eight-year-old female who had received an estimated 250 fluoroscopic examinations of the chest in the course of treatment of pulmonary tuberculosis and induction of therapeutic pneumothorax under direct fluoroscopic observation. After about seventeen years acute lymphatic leukemia developed.

Each of these cases of leukemia was acute, 5 were of the myeloid or myeloblastic type and 1 lymphocytic. Usually the disease had a pancytopenic onset necessitating bone marrow aspiration or biopsy for definitive diagnosis.

The author admits that the evidence of cause-and-effect relationships in these cases is fragmentary for the most part and by no means conclusive. He makes a plea for careful documentation and publishing of all information in as complete detail as possible in all cases of leukemia attributed to ionizing radiations.

One comprehensive table.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Estrogen Excretion in Breast Cancer Patients Before and After Ovarian Irradiation and Oophorectomy. E. Diczfalusy, G. Notter, F. Edsmyr, and A. Westman. J. Clin. Endocrinol. **19:** 1230–1244, October 1959. (Karolinska Sjukhuset, Stockholm, Sweden)

The recent development of chemical methods to estimate small amounts of urinary estrone, estradiol-17 β, and estriol offers a means of assessing the relative effectiveness of the various therapeutic measures to reduce endogenous estrogen excretion in the human female. In this manner a possible correlation between urinary estrogen excretion and the therapeutic results in mammary cancer may be evaluated.

A study of 17 premenopausal breast cancer patients at five intervals was made: (*a*) during the first part of the menstrual cycle, (*b*) during the second part of the cycle, (*c*) two months following ovarian irradiation, (*d*) four months following ovarian irradiation, and (*e*) two months following bilateral oophorectomy. Each patient received the same sequence of treatment and at exactly the same intervals. It was found that there is a large individual variation in estrogen excretion, with a range from 84 to 471 micrograms. It was noted, as expected, that the patients excreted significantly more estrogen in the second part of the cycle than in the first.

Ovarian irradiation resulted in a marked decrease in estrogen excretion, most notably in the estriol fraction, with a decrease of approximately 90 per cent as compared to 40 and 50 per cent for the estrone and estradiol-17β fractions. Subsequent oophorectomy did not result in any further reduction of the excretion of these estrogens. It is believed that the adrenals are a potential source of urinary estrogen in the oophorectomized patient.

Eight tables.

W. J. VARLEY, M.D.
Mercy Hospital, Pittsburgh

The Prevention of Radiation Lung Damage. A. G. W. Whitfield and W. H. Bond. J. Fac. Radiologists **10:** 181–185, October 1959. (Queen Elizabeth Hospital, University of Birmingham, Birmingham, England)

Efforts to minimize the development of pulmonary damage from radiation therapy through lung tissue have led to the use of anticoagulants during treatment. Reports have indicated that administration of heparin or Dicoumarol may have prevented lung fibrosis in certain patients. Steroids have appeared beneficial in the presence of established radiation lung damage; and the trial use of corticoids during treatment as a preventive has been suggested.

The authors report 8 cases in which wide-field irradiation was given to the thorax for various malignant processes, with simultaneous treatment by an anticoagulant (Dindevan). The dose was adjusted to give a prothrombin time of two to three times normal and was discontinued at the end of the period of radiotherapy. Radiation doses varied from 800 r tumor dose in fifteen days to 3,100 r in twenty-four days. In 3 of the 8 patients radiation damage to the lungs developed, and 1 suffered radiation damage to the heart.

Another 5 patients received, during thoracic irradiation, 75 to 100 mg. oral cortisone daily, which was continued three months after irradiation was completed. Tumor doses varied from 1,900 r in five days to 3,000 r in four weeks. Of these patients, 1 died from radiation lung damage, 1 suffered mild damage to one lung, and the remainder were free from radiation injury.

The authors show here that neither anticoagulants nor steroids are a complete safeguard, but their administration is relatively harmless, and they appear to give some degree of protection to the lungs. Knowledge of whether this is a real effect will depend upon the results of larger trials.

Four roentgenograms; 3 tables.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Radiation Fibrosis of Pericardium, with Cardiac Tamponade. Case Report with Post-Mortem Studies and Review of Literature. David W. Hurst. Canad. M. A. J. **81:** 377–380, Sept. 1, 1959. (Queen's University, Kingston, Ont., Canada)

What is believed to be the second recorded fatal case of pericardial thickening with effusion and cardiac tamponade, following roentgen therapy for breast cancer, is reported. The pathological changes in the heart, lungs, and pericardium are described and, on the basis of the microscopic findings, are thought to have been the result of irradiation.

The patient's right breast was removed September 1954 for adenocarcinoma and roentgen therapy was administered. In January 1956 she had a left radical mastectomy and bilateral oophorectomy after the discovery of carcinoma in the left breast, followed by a second course of radiotherapy. Fields exposed singly were the right and left supraclavicular and posterior axillary but two courses through the same anterior mediastinal field were given. The dose at the anterior

pericardium, allowing that soft-tissue absorption at that depth reduces the dose to 90 per cent and that absorption by 1 cm. of sternum decreases the estimated soft-tissue dosage to 84 per cent, is estimated to be 2,268 r for the first course and 2,532 r for the second course, for a total of 4,800 r.

Pericardial symptoms appeared twenty-two months after the second course of treatment. Since far higher doses than those described in this case have been given with no ill effects, it is obvious that individual tolerance varies widely. The danger of damage to the myocardium, which may well have been an additional factor in the cardiac failure of this case, must also be remembered.

Autopsy sections taken throughout the body failed to demonstrate the presence of secondary carcinoma.

Twelve photomicrographs.

Growth Disturbances of the Skeleton Following Radiation-Induced Infantile Myxedema. B. Freyer. Fortschr. a. d. Geb. d. Röntgenstrahlen **91:** 305–311, September 1959. (In German) (Rudolf-Virchow-Krankenhaus, Berlin, Germany)

Localized growth arrest is known to occur following irradiation of centers of ossification. Generalized retardation of bony development, however, can also be induced when the thyroid gland is rendered deficient by irradiation in early life. Formerly it has been the impression that ionizing rays have an effect only on hyperthyroid but not on euthyroid tissues. This belief is now being disproved by the author's recent observation.

A male, age 29, exhibited typical features of hypothyroidism and myxedema, associated with stunted growth of the entire skeleton with short extremities, delayed secondary ossification, and persistence of epiphyseal ossification centers.

At the age of five years a papilloma of the right vocal cord was removed but recurred repeatedly requiring fifteen operations. Emergency tracheotomy had also twice become necessary (1935, 1949). In 1925, low-voltage roentgen therapy was tried with a total dose of 950 r anteriorly, 1,000 r on the right side and 1,150 r on the left side. Recurrences of the papillomatosis continued, nevertheless.

For the past five years the patient had become increasingly obese, in spite of reduced caloric intake. He was short, 156 cm. in height, and had an infantile voice, as well as gynecomastia. The skin was dry and pasty. Indurated edema was noted on the dorsum of the hands and feet. Metacarpals and fingers were short. The neck presented old radiation damage and a tracheotomy scar.

The basal metabolic rate was −25 per cent and the radioiodine uptake of the thyroid area was nil. Cholesterol esters were increased, serum calcium and 17-ketosteroids were decreased, and inorganic serum phosphorus levels were elevated. The bone age was fourteen in the extremities and six years in the lower cervical and upper thoracic spine. The latter area had been in the cross-fire radiation field when the patient was six years old. Persistent epiphyses were present in the dorsolumbar spine, iliac crests, ischial tuberosities, acetabula, and acromial processes.

In retrospect, it is believed that surgery is still the method of choice for vocal cord lesions. When radiation therapy becomes necessary, as in this case, treatment with radioactive gold, strontium, or yttrium would nowadays be indicated. These elements allow strictly localized radiation with a sharp falling-off toward the surrounding healthy tissues. For treatment of adult cases, telecurietherapy with radium or radioactive cobalt would be advisable with a tumor dose of at least 3,000 r given through several small fields.

Seven roentgenograms; 3 photographs; 1 scanograph; 1 drawing. ERNEST KRAFT, M.D.
Northport, N. Y.

Radiation Hazards from Medical and Dental Uses of X-Ray. James B. Douglas. J. Kentucky State M. A. **57:** 1062–1065, September 1959. (University of Louisville School of Medicine, Louisville, Ky.)

The National Committee on Radiation Protection recommends that exposure from man-made radiation be kept below 10 r for the first thirty years of life. This does not mean, however, that such dosage is desirable and every effort should be made to keep the exposure as far below this level as possible while still making use of the great benefits of radiation.

Technics which lower exposure dose in fluoroscopy and radiography are suggested. High-kilovoltage, low-milliamperage settings are indicated. Increased filtration and more careful use of diaphragms, cones, and local shielding are recommended. High-speed screens, fast films, and complete development will also help reduce patient exposure. A recent demonstration showed a reduction from 6.9 r skin dose for a film of the pelvis to 0.2 r without any significant sacrifice in film quality.

When an x-ray examination is requested, it is imperative that the radiologist or physician or dentist responsible for carrying it out does not permit concern over exposure to impair the quality and dependability of the procedure. Where exposure is a factor, the job must be done correctly the first time while the dose is kept as low as possible, especially in young adults.

Radioactivity in Foods. Council on Foods and Nutrition, American Medical Association. Cyril L. Comar. J.A.M.A. **171:** 1221–1223, Oct. 31, 1959. (New York State Veterinary College, Cornell University, Ithaca, N. Y.)

Environmental contamination now existing is due almost entirely to fall-out from nuclear weapons. Although at the present time there is no indication for a change in our dietary habits, broad-scale research on the problem of radioactivity in foods and its implications must continue for future public welfare. Even if testing of nuclear weapons is halted, peacetime applications of atomic energy will release some radioactive materials into the environment. Therefore, close supervision of the dietary levels of radioisotopes and understanding of possible effects on man are necessary for the evaluation of atomic energy benefits versus biological cost.

One diagram; 2 tables.

Some Factors Involved in the Effect of X-Irradiation on the Phosphatase Activity of Hematopoietic Tissues. Edwin M. Uyeki and Paul R. Salerno. Blood **14:** 1128–1136, October 1959. (Western Reserve University, Cleveland, Ohio)

On the basis of animal experiments, the authors reach the following conclusions:

"Factors which modify lymphoid distribution of tissues were found to modify the adenosine triphosphatase activity of these tissues. Starvation or cortisone injection, which produces destructive changes in lymphoid

tissues, was found to increase the enzyme activity of spleen and thymus tissues. The greater increment of enzyme activity of the thymus as compared to that of the spleen was correlated with its normally higher content of lymphoid tissue.

"The increase in adenosine triphosphatase activity of hematopoietic tissues appears to be associated with the type of cells present in the assay medium. With respect to peripheral blood leukocytes of the rat, the cell type is confined largely to lymphocytes and granulocytes. The increase in adenosine triphosphatase activity of the leukocytes after total-body x-ray was seen to parallel the increase in granulocytes present in the assay medium. The ratio of granulocytes to lymphocytes is not appreciably altered in dog peripheral blood after exposure to total-body x-ray; the adenosine triphosphatase activity similarly was not significantly altered. After total-body x-ray (390 r and 780 r), cells isolated from the rat bone marrow displayed a fivefold increase in adenosine triphosphatase activity. This increase was seen to correspond with an increase in the ratio of segmented leukocytes and reticuloendothelial cells and a decrease in the immature forms of the erythroid and myeloid cells.

"The heterogeneous cell mixtures used for our assay procedures permit the observation that total-body x-irradiation results in an increased enzyme activity of the isolated cells of the peripheral blood, bone marrow and spleen tissue of the rat. The increased enzyme activity was associated with the increased ratio of cells with high enzyme activity present in the assay medium."

Three graphs; 2 tables. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Early Effects of X-Irradiation on Specific Renal Functions in Dogs. H. J. Klapproth, H. Takagi, and A. C. Corcoran. Lancet **2**: 161–162, Aug. 22, 1959. (H. J. K., St. Vincent Charity Hospital, Cleveland 15, Ohio)

A study was undertaken of the early structural and specific functional effects of irradiation on the kidney in the dog. The observations were made after x-irradiation of subcutaneously explanted kidneys of 3 uninephrectomized animals. Functions measured were plasma clearance of *p*-aminohippurate (P.A.H.) at low plasma concentrations ($C_{P.A.H.}$) and at concentrations appropriate for measurement of maximum tubular excretory capacity ($Tm_{P.A.H.}$), and glomerular filtration-rate from plasma clearance of exogenous creatine. In addition, maximum tubular reabsorptive capacity for glucose was determined in 2 dogs, following estimations of $Tm_{P.A.H.}$ and after intervals of several minutes to allow for excretion of excess P.A.H.

In 2 dogs the entire kidney was irradiated with a total of 1,800 and 3,600 r, respectively, administered in fractional doses of 600 r every other day with a conventional 200-kv high-voltage x-ray machine. In a third dog, 1,150 r was delivered in three equal doses at two-day intervals to the upper pole of the kidney.

These experiments showed that, in the dog, doses of irradiation such as are employed clinically in treatment of Wilms' tumor, para-aortic tumor metastases, and gastric ulcer may have significant initial, and also well recognized delayed injurious effects on renal function and structure. The initial injury is characterized by depression of tubular excretion of P.A.H.; plasma clearances of P.A.H. and creatinine may be only slightly depressed. Increments in glucose reabsorptive capacity were observed at three days after the cessation of irradiation in 2 dogs; these later subsided. The disparate changes in tubular transports of P.A.H. and glucose, the glomerulopathy found at necropsy in all 3 dogs, and the juxtaglomerular proliferation noted in 1 indicate the desirability of further evaluation of the early renal effects of irradiation.

One photograph; 2 photomicrographs; 1 table.

In the Sept. 5, 1959 issue of *Lancet*, John Hopewell comments that in considering the results of the above experiments, one must remember that a kidney cannot be regarded as normal in the weeks following opposite nephrectomy. It must be expected to exhibit the microscopic and functional changes of adaptive response to its increased excretory load. These changes are believed to be the same, however they are effected. An investigation of changes resulting from reabsorption from long ileal segments in the dog revealed a progressive increase in the plasma clearance up to about the eighth or tenth week after the kidney is exposed to increased load. The reduced clearances observed by Dr. Klapproth *et al.* after irradiation, therefore, gain significance when they are compared, not with normal figures, but with the higher clearance expected from a kidney undergoing hypertrophy following opposite nephrectomy.

Value of Bone Marrow and Spleen Cell Suspensions for Survival of Lethally Irradiated Dogs. Robert D. Sullivan, Gisela Stecher, and Stephen S. Sternberg. J. Nat. Cancer Inst. **23**: 367–383, September 1959. (Sloan-Kettering Institute, New York, N. Y.)

The protective effect of homologous spleen and homologous marrow and autologous spleen and autologous marrow was studied in 85 mongrel dogs after their single exposure to lethal doses of total-body x-radiation. In the autologous experiments the material was administered intravenously and intra-arterially immediately after irradiation, while in the homologous experiments the cell suspensions were given as late as twenty-four hours after irradiation. No protection was noted with these technics at radiation dose levels of 600 r, 550 r, and 450 r. Survival was somewhat longer at 450 r than at 600 r for both treated and control groups. Within the treated groups, however, there was no appreciable difference in survival at these radiation dosage levels relative to the type of protection used, *i.e.*, spleen-cell suspensions or bone-marrow suspensions—autologous or homologous, nor in relation to the time of administration of homologous marrow, whether immediately or up to twenty-four hours after irradiation. The use of antibiotics and cortisone was likewise without significant protective effect. In most animals of all groups, the white blood count was depressed to less than 1,000 cells per millimeter by the sixth to the ninth day, and at autopsy, marrow and lymphoid aplasia were found.

Significant protection was evident when autologous marrow was administered at radiation dose levels of 400 r. White cell count depression was less severe for the treated than for the control group. Surviving dogs were killed and were found to have normal hematopoietic and lymphatic systems.

It is concluded that viable homologous or autologous spleen and marrow-cell suspensions failed to protect the mongrel dog against supralethal doses of total-body radiation, but autologous marrow afforded some benefit at marginally lethal dosage levels.

Four figures; 3 tables.

The Combined Effects of Ionizing Radiation and High Temperature on the Longevity of the Sprague-Dawley Rat. L. D. Carlson and B. H. Jackson. Radiation Res. **11:** 509–519, October 1959. (University of Washington School of Medicine, Seattle, Wash.)

Though ionizing radiation has been found to accelerate the aging process, chronic low-level irradiation has been shown by Lorenz (Am. J. Roentgenol. **63:** 176, 1950. Abst. in Radiology **56:** 161, 1951) to prolong life expectancy in mice, while Carlson (Radiation Res. **7:** 190, 1957) has increased the life span of rats by exposure to 0.1 r/hr. for eight hours a day for a year of adult life plus the additional stress of cold exposure. These studies have been extended.

Male Sprague-Dawley rats of the same age were selected by weight and growth rate and divided into eight groups of 22 each. The animals were individually caged and exposed to low-level irradiation from a Co^{60} source for sixteen hours a day. Irradiation was begun at four months of age and ended at sixteen months of age. Four groups of rats were kept at 28° ± 1° C. throughout the experiment; these animals were exposed to 0.29, 0.64, 2.60, and 4.18 r/day during the irradiation period. The other four groups of animals were kept at 35° ± 1° C. during the period of irradiation and at 28° C. during the pre- and postirradiation periods; they were exposed to 0.28, 0.60, 2.57, and 3.96 r/day.

At 35° C. the ET 50 [days of age at which 50 per cent of animals are dead] for 0.29 r/day was 310; for 0.64 r/day it was 490; for 2.60 r/day it was 540; and for 4.18 r/day it was 510. At 28° C. the ET 50 for 0.28 r/day was 493; for 0.60 r/day it was 510; for 2.57 r/day it was 650; and for 3.96 r/day it was 590. With the exception of the relation between 0.60 and 0.28 r/day, the data are statistically significant at the 5 per cent level. From a previous experiment at 26° C. the ET 50 for 0 r/day was 445, and for 0.8 r/day it was 585. It is suggested that the effects of ionizing irradiation interact with the effects of environment in influencing longevity.

Eight figures; 3 tables.

Attempts to Reproduce Cirrhosis of the Liver in Rats After Total-Body X Irradiation. Harold W. Carroll, Alfred P. Spivack, and Ralph W. Brauer. J. Nat. Cancer Inst. **23:** 669–673, October 1959. (U. S. Naval Radiological Defense Laboratory, San Francisco, Calif.)

Evidence is accumulating that animals which have sustained a radiation exposure and survived appear to recover to a degree which makes them superficially indistinguishable from controls. Such animals, however, have a reduced life expectancy and perhaps other physiologic and biochemical incompetency. Previous reports suggested to the present authors that superposition of a low-protein diet on "apparently recovered" animals might prove useful in unmasking an otherwise unapparent injury.

Attempts were made to reproduce the experiments of White (J. Nat. Cancer Inst. **15:** 1155, 1955. Abst. in Radiology **66:** 164, 1956) with weanling male and female rats (169 in all). All were given a low-protein diet (6 per cent casein) before exposure to radiation, during exposure, during recovery, and after apparent recovery was complete. Seventy-eight animals were used as controls. With the exception of one group of 20 rats which received a single exposure dose of 475 r, all animals received 200 r a week for five consecutive weeks, for a total of 1,000 r. Additional vitamin supplementation in one group was intended to preclude the possibility of deficiencies of lipotropic factors.

All the rats had fatty infiltration and varying degrees of fibrous proliferation of the liver regardless of whole-body x-irradiation. Vitamin supplementation reduced the fatty infiltration to some degree and all but eliminated fibrous proliferation; minimal cirrhosis was observed in 3 older groups and indicated the possibility of an age dependence in production of the lesions; fibrosis was seen generally in the animals with the most severe degree of fatty infiltration.

These results are obviously at variance with those of White, who reported cirrhosis in 53 per cent of the irradiated survivors with none in the controls. In the present experiment lesions developed regardless of radiation exposure, and this suggests that they are of dietary origin.

It is pointed out that, although the diet composition used here was the same as that reported by White, the dietary ingredients probably were not procured from the same source. Crude casein, especially, varies greatly in quantity of total nitrogen from one lot to another. Also, although the strain of rats employed here and previously were nominally the same, isolation of substrains from the parental strain for some time could lead to differences in cirrhotogenic tendencies, due possibly to unconscious selective breeding.

Three tables.

Polydipsia and Polyuria by the X-Irradiated Rat. Robert E. Kay and Cecil Entenman. Am. J. Physiol. **197:** 169–172, July 1959. (U. S. Naval Radiological Defense Laboratory, San Francisco, Calif.)

Many investigators have found that rats exposed to whole-body x-irradiation have a marked polyuria and polydipsia. This has been attributed by some to the direct action of x-rays upon the pituitary gland. The authors have noted, however, that head-irradiated rats do not have a polyuria, whereas head-shielded irradiated rats do. To investigate the possibility that x-irradiation of other organs may produce a substance or condition which acts in conjunction with the pituitary to cause polyuria, urine output and water intake was determined following partial-body x-irradiation and whole body x-irradiation of organectomized rats.

The results of the partial-body irradiation experiments establish the abdomen as the radiosensitive area involved in postirradiation polydipsia and polyuria. The responses, however, do not appear to be due to the action of x-rays on any one organ in this region, since irradiation of individual exteriorized organs was only partially effective. On the other hand, shielding of the exteriorized kidneys or liver was effective in the prevention of postirradiation polyuria and polydipsia. Removal of the adrenal glands or spleen prior to irradiation did not prevent polydipsia or polyuria, whereas removal of the pancreas greatly diminished the extent of the polydipsia and polyuria and removal of the pituitary eliminated the responses. Anoxic anoxia during the time of irradiation did not prevent polyuria or polydipsia, but when isotonic sugar solutions were given as the drinking fluid, polyuria and polydipsia did not occur.

Five tables.

Effect of Roentgen Irradiation of Lymphocytes in Vivo. G. H. Hjort. Acta radiol. **52**: 315–320, October 1959. (Department of Radiotherapeutics, University of Cambridge, England)

The author reports an investigation of the effect of roentgen irradiation of lymphocytes *in vivo*. Rats were placed in a box and irradiated with doses ranging from 75 to 1,200 r; controls were carried though the whole process without being irradiated. All animals were killed one to six hours after irradiation or the sham procedure. A lymph node from the neck was removed and placed on a microscopic slide in a drop of 0.9 per cent NaCl. The tissue was minced with a knife and a drop of the fluid transferred to a clean slide upon which it was spread in a thin layer and then fixed. A thousand cells were counted in each preparation and the number of cells with pyknotic nuclei or intranuclear vacuoles registered as damaged cells.

Plotting of the time-effect curve for different roentgen doses showed that the surviving fraction of the cells decreased exponentially after a latent period of about one hour. The mean survival time of the lymphocytes decreased rapidly with increasing dose.

The dose-effect curve for the lymphocytes followed a straight line on logarithmic probability paper; from this the LD 50 dose could be calculated. It was found that 30 r is the lowest dose which produces a significant increase in the number of cells with pyknotic nuclei.

Two diagrams; 2 tables.

Weight, Nitrogen and DNA Content of Small Intestine Mucosa of Rats Exposed to X-Rays. Robert E. Kay and Cecil Entenman. Am. J. Physiol. **197**: 13–18, July 1959. (U. S. Naval Radiological Defense Laboratory, San Francisco, Calif.)

The quantitative relationships between the changes in small intestine weight, mucosa weight, mucosa DNA (desoxyribose nucleic acid) and nitrogen following exposure to x-rays were investigated in rats receiving whole-body 250-kvp irradiation (15 ma, 0.5 mm. Cu plus 1 mm. Al filter, 1.5 mm. Cu half-value layer) at a rate of 27 r/min. (measured in air) and at a target-to-skin distance of 40 inches. The x-ray dosage employed in the experiments ranged from 100 to 1,500 r. In one experiment, one group of fasting rats received 600 r, a second group 600 r plus 600 r one day later, a third group 600 r plus 600 r two days later, and a fourth 600 r plus 600 r three days later.

It was found that the relationships mentioned above depend upon the magnitude of the dose, time of observation, nutritional state of the rat, and number of doses administered. Thus, depending on the particular combination of these variables, different effects of irradiation on mucosa weight, intestine weight, and mucosa DNA and nitrogen were observed. The following relationships were found: (1) Weight changes in the small intestine always reflected the changes in mucosa weight. (2) Changes in mucosa nitrogen after a single irradiation always paralleled the changes in mucosa weight, whereas the changes in mucosa DNA were not as closely related to the weight changes. (3) Changes in mucosa weight and nitrogen did not correlate well with the dose received, whereas DNA level approximated a linear relationship over the range 300 to 900 r. (4) There was a minimum level to which the mucosa weight, DNA, and nitrogen decreased following irradiation.

Five figures; 1 table.

The Depletion of the Myelopoietic Cells of the Irradiated Rat. E. V. Hulse. Brit. J. Haemat. **5**: 369–378, October 1959. (Harwell, Didcot, Berks., England)

The effects of x-rays on the myeloid cells of the blood and bone marrow were studied by a quantitative technic. For these investigations adult male rats were used. Cell suspensions were prepared from marrow removed from one femur and an air-dried smear was obtained from the other. Cell counts were made on the suspensions and the numbers of nucleated cells per cubic millimeter of marrow were calculated. These results were combined with differential counts of the smears, and the absolute numbers of each type of cell present were thus obtained. Total white-cell counts and differential counts were performed on the blood of the same animal so that changes in the blood and marrow could be compared.

With irradiation of 75 to 600 r the findings in the irradiated animals did not differ significantly from those in the controls, but after lower doses (25 and 50 r) and higher doses (800 and 1000 r) there were observable differences.

In the neutrophil series two groups of changes were observed: (1) a depletion of the various neutrophil precursors and (2) a transient increase of neutrophils in the blood and the appearance of segmented myelocytes and hypersegmented neutrophils in the marrow. The first group of changes, which led eventually to the depletion of more mature forms, are of the type envisaged by classical radiobiological theory. They are discussed in relation to the time taken for neutrophil maturation. It is considered that the second group may be regarded either as a form of post-irradiation aging, or as an accentuation of normal degeneration, concepts which are not exclusive of one another.

The eosinophil series were found to be as sensitive to ionizing radiation as the neutrophils. Unlike the neutrophils, some eosinophils developed pyknotic nuclei and, insteading of increasing in numbers, the circulating eosinophils were reduced in numbers shortly after irradiation. The relationship of the eosinophil response to postirradiation adrenal function is briefly discussed.

Six photomicrographs; 3 tables.

Late Effects of Fast Neutrons versus X-Rays in Mice: Nephrosclerosis, Tumors, Longevity. Peter C. Nowell and Leonard J. Cole. Radiation Res. **11**: 545–556, October 1959. (P.C.N., School of Medicine, University of Pennsylvania, Philadelphia, Penna.)

The authors have made a study of the incidence of various late lesions in fast-neutron-irradiated mice and mice exposed to 250-kv x-rays.

Groups of LAf_1 mice exposed to sublethal doses of fast neutrons (290 to 580 rads) or to lethal doses of x-rays (800 r or 1,000 to 1,100 r) were followed until natural death in order to observe long-term irradiation effects. Irradiated mice were protected against acute death by injection of hematopoietic cells or limb shielding.

In the neutron-irradiated group, 41 of 310 mice (13 per cent) were found to have mucoid adenocarcinomas of the cecum or small intestine, while in the 800 r x-irradiated group, only 8 of 285 mice (3 per cent) had intestinal adenocarcinomas. This indicates a relative biological effectiveness (RBE) of 2 to 3 for neutrons in the induction of these tumors.

A group of 109 mice received a single exposure of 250-kv x-rays of from 1,000 to 1,100 r, with the marrow of one limb shielded. After this supralethal dose, a large number of mice succumbed with acute "intestinal deaths," and only 32 mice were alive at thirty days. Of these, 19 came to autopsy for long-term study. Although this group is too small for definite conclusions, the finding of 4 intestinal carcinomas in 19 animals (21 per cent) suggests an incidence in the same range as the neutron group.

Nephrosclerosis, on the other hand, was more common in the x-irradiated than the neutron-irradiated mice, with an apparent neutron RBE value close to unity.

The mortality curves for the x-irradiated (800 r) and 8-Mev neutron-irradiated mice were essentially the same, with 50 per cent of the irradiated animals dead approximately eight months earlier than 50 per cent of the nonirradiated controls.

Several possible explanations for the findings are presented and discussed.

One figure; 6 tables.

Effect of Repeated Whole-Body X-Irradiation on Peripheral White Blood Cell Count of Rabbits. Herbert B. Gerstner and Harry A. Gorman. Am. J. Physiol. **197:** 568–570, September 1959. (School of Aviation Medicine, USAF, Randolph Air Force Base, Texas)

Six groups of rabbits were given whole-body x-irradiation of 0, 100, 200, 300, 400, and 500 r, respectively. Counts of total white blood cells were performed regularly until eleven weeks postexposure, when radiation-induced leukopenia had disappeared in all groups. At that time, the animals were re-exposed to the same doses and white cells were once more counted throughout eleven weeks. Then followed a third application of the same doses of irradiation with subsequent observation of white counts. Statistical analysis of data yielded the following results: in the three exposures, radiation-induced leukopenia showed no significant difference with respect to rate of development, maximal degree, and rate of disappearance. Therefore, as judged by the white blood cell count, susceptibility to ionizing radiation appeared unaltered by previous exposures to appreciable doses when the interval between exposures was sufficiently long to permit complete hematopoietic recovery.

Two figures; 1 table. AUTHORS' SUMMARY

The Effect of X-Rays, Grenz Rays, Thorium-X, and Radioactive Phosphorus on Superficial Mycotic Agents. Samuel Monash and Frank J. Roth, Jr. Arch. Dermat. **80:** 288–293, September 1959. (Jackson Memorial Hospital, Miami 36, Fla.)

The effects of x-rays, grenz rays, thorium-X, and radioactive phosphorus on a variety of pathogenic fungi was studied. It was found that all these types of radiation produced partial or complete inhibition of growth. In some strains subinhibitory doses appeared to produce a stimulatory effect, as shown by an acceleration of growth and the production of an increased number of conidial structures. Colonies exposed to a near-lethal dose were generally characterized by a loss or reduction in the numbers of defined morphologic entities. In some cases variations in pigment production and mycelium formation were observed. Complete inhibition by x-rays required 200,000 to 300,000 r units and by grenz rays, 390,000 to 600,000 r units. In a few experiments with *C. albicans*, 190,000 r units of grenz rays completely inhibited growth.

Eight photographs; 2 tables.